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A CONSIDERATION of the UREA EXCRETION in
LOBAR PNEUMONIA.

Its Relation to Temperature, Diet, Pulse,
Respirations, and Amount of Urine Secretion
over the Course of the Disease; with remarks
on the Relation of Pulse and Respirations to
the Temperature in each Case.

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A General Consideration of the Nitrogenous Excretion in the Body.

In healthy adults the kidneys are the channels by which nearly all the nitrogen, eliminated from the body, is excreted. The average nitrogen excretion per 24 hours varies from 10 to 16 grams and in the urine the daily percentage is found to be from 0.8 to 1.05.¹

The excretion by the other channels of nitrogenous output - the bowel, sweat, and sputum - varies.

The average excreted in the Faeces is 7 to 8 per cent in the 24 hours. It may be much less if large quantities of water are swallowed, or in conditions which further the assimilation of nitrogenous foods, in which cases more of the eliminated nitrogen appears in the urine as urea.²

The excretion of nitrogen in the Sputum has been found by Von Jaksch and Lanz³, to be very small in amount. It occurs chiefly in combination in albumen. These observers found the excretion increased in some forms of disease, notably Phthisis and Lobar Pneumonia, but the percentage amount was still small, the average in Pneumonia /

1. Dixon Mann ("Phys. & Path. of Urine" p. 129, 1904. Edn.
2. Do. Do. Do.
3. Von Jaksch ("Clin. Diagnosis", 1905, pp. 159 et seq).

Pneumonia being 1.778 per cent (only a small percentage of this occurs as Urea). The amount in the Sweat in health varies greatly for obvious reasons, but the average percentage of nitrogen excreted is very small, not exceeding 0.4 per cent.¹

We shall now consider the relation of Urea excretion to the Nitrogen excretion in health and in disease.

Before proceeding to this discussion it is necessary to observe that the Urea excretion is not necessarily to be regarded as a measure of the Proteid katabolism in the whole body either in health or in disease (e.g., Lobar Pneumonia). Folin and Leathes² hold that a proportion of the Urea excreted may represent the excess of Nitrogen in the Proteid of the food, which, not being needed by the cells of the Organism, is passed direct through the blood to the kidneys, from the seat of its transformation to Urea in the Liver, and excreted. This probably accounts, as Leathes suggests, for the common observation that there is an increase in Urea excretion for a time after food. The marked fall in Urea excretion relatively to other Nitrogen-bearing substances (e.g., Kreatinin, Ammonia, Uric Acid, etc.) which /

1. Halliburton in "Kirke's Physiology" 1900, p. 562.
2. J. B. Leathes, "Problems in Animal Metabolism" 1906. pp. 155 et seq.)

which is noted on a Nitrogen-free diet may, Folin and Lang suggest,¹ have a similar explanation.

The question of diet may be observed, therefore, to influence the amount of Urea excretion markedly. The amount of exercise is also known to influence the amount of Urea excretion, but to a slight extent.

We are only interested in these questions however, in so far as they appear to affect our observations on, and inferences from, the amount of Urea excretion in the cases we shall discuss later in this article. We shall, therefore, consider them when noting the general conditions under which our observations were made.

(a) Relation in Health. In health the nitrogenous waste of the Organism is for the most part excreted as Urea. The earlier observers assessed the percentage of Urea in the daily Nitrogen output at from 84 per cent to 88 per cent, but the most recent investigations shew that 90 per cent. or more² of the Nitrogen leaves the body as Urea.

The Urea is in health excreted almost wholly in the Urine. The percentage amount in the Sweat has been found to be so low as 0.08 per cent. to /

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1. Leathes "Problems in Animal Metabolism", p. 162.
 2. Von Jaksch & Garrod, "Clin. Diagnosis" pt. 409 & 417.
J.B. Leathes, "Animal Metabolism" p.144.

to 0.05 per cent or less¹

In the Faeces. Urea forms, under healthy conditions, only a very minute percentage of the total Nitrogen excretion in the Faeces. This latter, as we have seen, amounts to 7 or 8 per cent. of the total average daily output of faecal matter, which is from 6 to 8 ounces in a healthy human adult.² The percentage of Urea passed by the bowel in health is therefore very small in amount.

The Sputum in health has been shewn by Hoppe Seyler and Theirfelder³ to contain usually less than 0.4 per cent. of Nitrogen and that practically all in combination in various albumens; so that the amount of Urea in the Sputum in health is very small.

The total excretion by the Kidneys varies greatly. In a series of healthy adult cases examined by Parkes⁴ the average was 371.5 grains per 24 hours. C.J. Lehmann's series (quoted by Parkes. Ibid) gave an average of 501.6 grs. A number of different observers' results are quoted, the highest average being that of Hammond of Boston, U.S.A., namely, 670.6 grs. per 24 hours.

But 450 to 500 grs. per 24 hours is nowadays accepted /

1. Dixon Mann, "Phys. & Path. of Urine", p.131.
Kirke's "Physiology" 1900 Edition, p.563.
2. Do. Do. Do. p.502.
3. Hoppe Seyler & Theirfelder "Handbuch der Physiologischen und Path. Chem. Analyse", p. 305, 6th Edition.
4. Parkes' "Composition of Urine", 1860, p.270 et.sēq.

accepted as the average in healthy adults. The amount varies with the body weight in each individual. In children the average daily excretion is actually less, though relatively more, than in adults. Dixon Mann¹ says that adults excrete in health from 0.4 to 0.6 of a gram per kilo of body weight, whilst a child excretes nearly 1 gram per kilo on an average.

(b) In Disease. I do not propose to discuss the Urea excretion in disease further than in so far as concerns the appearances to be observed in Lobar Pneumonia.

The Urea Excretion in Lobar Pneumonia.

The Urea excreted in the Fastigium in this disease must to a considerable extent, be a product of tissue katabolism as the amount of proteid taken in the pyrexial period (40 to 70 oz. milk per day in adults, 20 to 30 in children, containing about 3 per cent. of albumen usually in the following cases) is relatively small, and the amount digested is likely to be considerably smaller, considering the disturbed state of digestion.

According to Haig², the amount of albumens, in grains, needed to supply the necessary Nitrogen to maintain nitrogenous equilibrium, can be estimated by /

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1. Dixon Mann, "Phys. & Path. Urine" 1904, p.131.
 2. Haig, "Diet and Food" 1898, p. 6.

by multiplying the average Urea output, in grains, in health by 3 (if life is sedentary - as it may be considered to be in the fastigium in Pneumonia). Again he points out¹ that most Physiologists agree, that, to maintain good nutrition in adults, about $3\frac{1}{2}$ grs. of Urea, per lb. of body weight per day, are necessary. Therefore, by multiplying the body weight in lbs. of any individual healthy adult by $3\frac{1}{2}$, we get the Urea required, and if this again is multiplied by 3, we get the albumen required to produce it. Now from different works² we get the information that the average weight varies from about 10 st. 5 lbs. at 20 years to about 11 st. 6 lbs. at 35 years. Suppose then a patient of 11 st. To get the albumens necessary for such a patient we multiply the weight in lbs. (154 lbs.) by $3\frac{1}{2}$ and then by 3.

$$154 \times 3\frac{1}{2} \times 3 = 1,617 \text{ grs. of albumens necessary to maintain proper nitrogenous equilibrium.}$$

But according to Parkes Hygiene (5th Ed.) ordinary new cow's milk has 3 to $3\frac{1}{2}$ per cent of albumens; then, 1,617 grs. albumen represent 123 oz. of milk, containing 3 per cent albumens.

We see then that the amount of Nitrogen which

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1. Haig, "Diet & Food", 1898, p.6.
 2. Treves, "Physical Education" tables.
 Roberts, "Manual of Anthropometry" tables.
 Quetelet's tables.

a patient of 11 st. (or even of considerably less weight) would get from 40 to 70 oz. of milk, is far below the amount necessary in the 24 hours to maintain nitrogenous equilibrium.

The main channels of Urea excretion in Lobar Pneumonia are the same as in health, namely, the Urine, Faeces, Sweat, and Sputum. Of these ways the Urine accounts for nearly all of the Urea excreted.

The Sweat. Dixon Mann¹ appears to suggest that occasionally Urea has been found in considerable amount in the sweat of Pneumonia. Such an occurrence cannot be common. On three occasions in which I have collected the Sweat - by enclosing the right arm of a pneumonia subject to above the elbow in a vessel such as is used in Bier's method of venous congestion, and making it airtight, then keeping it in place for 12 hours, at the end of which period the accumulated sweat was collected and tested for Urea by Hopkins' method - I have had difficulty in estimation owing to the small amount present. In considering the question of /

1. Dixon Mann, "Phys. and Path. Urine", p. 131.

of Urea excretion in uncomplicated cases of Lobar Pneumonia, I think the amount excreted in the sweat will affect our conclusions little from the clinical standpoint.

Much the same may be said of the Urea excretion in the Sputum in all but a few cases - and probably none of these latter uncomplicated.

Von Jaksch and F. Lanz¹ estimated the total Nitrogen in the Sputum in a number of cases of Lobar Pneumonia. They found the average amount in their series to be 1.7784 per cent. of Nitrogen, the vast majority of which occurred as albumen. The amount of Urea present in the Sputum in the cases of their series must then have been very minute indeed.

Unless when severe diarrhœa occurs in this disease, the amount of Urea in the Fæces is probably not greater than in health.

The Urea excretion in the Urine will form the chief point of discussion in this Thesis.

Note. Before proceeding to a detailed discussion of the cases which have been examined, it is necessary to note under what conditions the examinations were conducted, and also to examine briefly the literature extant on the subject. We shall consider the latter question first.

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1. Von Jaksch, "Clin. Diagnosis" p. 159. 1905 Edn.

A brief consideration of the Literature on the question of the Urea and Urine output in Lobar Pneumonia.

Parkes¹ says : It is a matter of common observation that the Urine in the Fastigium is lessened to about $\frac{1}{3}$ or $\frac{1}{2}$ of its normal amount. This fact is most marked in the early days of the Fastigium.

During the stage of complete resolution the amount of Urine increases, and sometimes may even surpass the normal. This diminution is not dependent on lessened ingress of water, and cannot be altogether accounted for by loss in the Sweat or Faeces, as it is evident in cases where no sweating or diarrhoea occurred. He thinks there is a retention of water in the body during the Fastigium.

He observes an increase in Urine at the end of the pyrexia.

The Urea. He says that beyond doubt there is an increase beyond the physiological limit in many cases. He quotes a series of averages obtained by himself, Brattler, Moos, Alfred Vogel, Wachsmuth, Julius Vogel, Zimmermann, and Metzger, taken in different cases over periods extending from the fourth to the tenth days of the Fastigium, in which the average amounts vary from 516 grs. to 1,321 grs. /

1. "Composition of the Urine", 1860, p. 270.

grs. per 24 hours. He holds that the greatness of the excretion is not dependent on the diet, the amount of water drunk, or on bodily movements of any kind, and he concludes that it must depend on the pyrexia.

He quotes different observers as shewing that the day on which the greatest total amount of Urea is excreted varies in different cases. In two cases in which examination was begun on the second day, the amount on the second and third days was small, but rapidly increased on the following day.

He quotes Wachsmuth as having proved that in equal periods the Urea excretion during the day is greater than during the night. He does not make it clear, however, whether he refers to the fastigium or to the period of convalescence.

He states that Vogel, Moos, and Wachsmuth are all agreed that the Urea excretion was greater in amount before than during resolution; but in some cases of his own he found the Urea high during convalescence.

He concludes however, by saying that the greatest Urea output corresponds to the highest temperature, and thinks the increase due to general increased metamorphosis. During resolution when the /

the temperature is normal, yet the Urea is high. This increase in Urea, he thinks, may arise either from absorption and metamorphosis of exudation, or may have been formed some time previously, but retained till this period.

Samuel West¹ agrees with Parkes in his conclusions regarding the diminution in the amount of Urine in the Fastigium. He does not observe any definite relation between the amount of Urine and the temperature or the diet.

He agrees with Parkes that the Urine returns to normal during convalescence.

He finds the Urea percentage very high in the Fastigium in his own cases, and he says it remains very constant. He quotes Moos, Vogel, and Unruh to the same effect.

The only relationship which he notes between the Urea percentage and the temperature is that mentioned, and the fact that there is a fall in Urea percentage with the fall in temperature at the period of crisis.

He finds his results differing from those of Parkes and most previous observers as regards the amount /

1. Trans. Medico-Chirurg. Society, London, 1874.

amount of average daily Urea output in the Fastigium. It is markedly low in all his cases. There are variations in the amount from day to day, which are independent of diet and temperature.

He agrees with previous observers that the Urea output is low during the earlier portion of the period of convalescence, increasing later; and that it shews variations from day to day.

He thinks that, taking into account the results of previous observers, there must be two classes of cases :-

- (1) Those in which the Urea is increased in the Fastigium,
- (2) Those in which the Urea is diminished in the Fastigium.

He notes at times an increase in the Urea percentage with the change of diet in convalescence.

He finds that the Urea percentage first shews a gradual fall for a time after the temperature reaches normal, and then a gradual rise occurs to between 1.5 per cent. and 2 per cent., where it becomes constant.

Sturges and Coupland¹ appear to incline to the views enunciated by Dr Samuel West; though they do /

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1. "Pneumonia", Second Edition, 1892.

do not bring forward any cases, nor do they state any very definite opinion on the question of Urea.

Vierordt¹ states that the Urea is absolutely increased in the Fastigium of Lobar Pneumonia.

He speaks of the 'very decided increase' in amount of excretion of Urea which occurs immediately after the Crisis in Pneumonia. He thinks it probably connected with the increase in amount of water secreted by the Kidneys at that time.

Coats² in discussing Fever in general, speaks of an increased Urea output in the first two days or so of convalescence. This he calls the "epi-critical" excess. He says this excess, in some cases at least, is due to a retention of Urea during the latter part of the Fastigium.

Clifford Allbutt³ has noted the above appearance in Lobar Pneumonia, but thinks it due to the absorption of the pneumonic exudate in the affected lung at the time of the Crisis.

Halliburton⁴ says that increased nitrogenous metabolism in Fever has been observed in Pneumonia.

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1. Vierordt (Trans by Stewart) "Medical Diagnosis", 1900, p.392.
2. Pathology, 1895, p. 408.
3. System of Medicine, Vol.V. "Pneumonia."
4. Kirke's Physiology, 1900, p. 575.

He continues: "What is known as the epicritical
 "increase in Urea is the greatly increased secretion
 "of Urea that occurs at the commencement of the de-
 "fervescence of Fever. It is probably not due to
 " an increased formation of Urea, but to the removal
 " of Urea which has accumulated, owing to the fact
 "that the Kidneys have been acting sluggishly during
 "the height of the Fever".

Von Jaksch¹ states that there is an increased
 excretion of Urea in children during the febrile per-
 iod of Lobar Pneumonia.

Osler² says: "In Pneumonia the Urea and Uric
 "Acid are usually increased at first, but may be much
 "diminished before the Crisis, to increase greatly with
 " its onset. At the Crisis there may be a marked in-
 "crease in the amount of Urine, which is heavily laden
 "with Urates and Extractives".

Frederick Taylor³ says: "In relation to disease, the
 "daily amount of Urea output must be considered quite as
 " much as the percentage, which may be in-
 " creased owing to loss of water by
 "other/

1. Garrod (See above)
2. Principles & Practice of Medicine. 1901. p.122.
3. The Practice of Medicine, 1901, p. 809.

"other channels (Sweating, etc.), while the daily
"Urea is normal."

Hilton-Fagge (Pye-Smith)¹ speaks much to the
same effect as these latter writers.

White and Martin² state that the Urea is in-
creased in Fever, but make no special reference to
the conditions observed in Pneumonia.

Allchin³ says : "During the febrile stage
"(in Lobar Pneumonia) the Urine is decreased in
"amount and increased in acidity and density, be-
"ing usually loaded with Urea and containing an
"excess of Uric Acid. After the Crisis the Urea
"diminishes."

Eustace Smith⁴ says that (in children) the
Urine is diminished in quantity in the Fastigium.
The excretion of Urea is above the average in
health.

1. Practice of Medicine, 1901, p. 809.
2. Genito Urinary and Venereal diseases, 1902, p.619
3. "Manual of Medicine", Vol. IV. p. 201.
4. "Disease in Children" 2nd Edition, p. 450.

A Note on the Conditions under which Observations were conducted.

The cases, which I shall bring forward to illustrate my conclusions in regard to the question of Urea excretion in Lobar Pneumonia, came under my observation in the Wards of the Glasgow Royal Infirmary. Some of them I observed during my period of residence there as Assistant to Dr D. C. McVail. Others I have been enabled to observe through the kindness of Dr T. K. Monro, Consulting Physician to the Infirmary, who allowed me to work in his Wards over a considerable period; and others again in the Wards of Drs. McKenzie Anderson and W. K. Hunter, to whom I am indebted for a like kindness.

The temperature in all the cases was noted every four hours, and it may be taken as sufficient to indicate the general condition of animal heat in the different subjects during the various periods of the disease.

The patients were all kept in bed from before the period, when a start was made in the collection of the Urine,, till some time - 7 to 10 days or longer - after the fall of the temperature finally to normal; so that all were kept so during the course of the experiments, except for three days at the end of one case.

Urine /

Urine. In some of the cases the Urine was collected as it was passed during the 24 hour period of each day, and stored in clean air-tight jars.

In most of the cases, however, the Urine was collected separately for each four-hourly period of the day and night, as it was desired to observe the relationship - if such existed - between the oscillations of the temperature, pulse, amount of diet, etc., and the amount of Urea and Urine.

The last specimen in each period (four-hourly or twentyfour-hourly as the case might be) was always collected exactly at the end of the period. The whole amount of Urine passed in the period was mixed, the quantity noted, and a specimen taken and subjected to the process for estimation of the contained Urea.

At the beginning of observations in each case, the process of collection was inaugurated by getting the patient to micturate immediately before the beginning of the first period (twentyfour-hourly or four-hourly, as the case might be). This "preliminary" Urine was discarded, but all Urine passed subsequently was kept as stated above till the collection and examination of the amount for the period, in /

in which it was passed, was made. Thus the observations were not hampered by the fear of incorrect results from improper collection of Urine.

Diet. The sole diet in each case, from the commencement of our observations till a variable time after the temperature first fell to normal, was milk. This was plain, cold, fresh milk, containing approximately 3 to $3\frac{1}{2}$ per cent. of albumens, the source of supply being always the same. The patient was fed with this milk at more or less regular intervals. In some of the charts, only the amount taken in each twentyfour-hourly period is noted. In others, the amount is noted for each four-hourly period. In two of the cases, the patient was put on a definite quantity of milk, which was given at definite intervals (cases VII and IX).

No other fluid or solid was allowed, and in no case was any drug administered by the mouth.

The pulse and respirations were noted four-hourly with the temperature.

A leucocyte count was made daily till after the temperature reached normal in nearly all the cases.

Estimation /

Estimation of Urea. The process followed in all cases was that, depending upon the re-action of Sodium Hypobromite (Gerard's Apparatus) on Urea. This method is not as accurate, of course, as Kjeldahl's method, but it gives a closely approximate estimate of the Urea, and I employed it for the following reasons :-

(1) My object has been chiefly to observe the relative excretion for different periods in the same case, and in different cases. Now, the degree of inaccuracy of the method is very constant in all cases where there is no sugar in the Urine - i.e., about 92 per cent. of the Nitrogen of the Urea is the usual amount given off in this process. This inaccuracy is allowed for in the Gerard instrument.

(2) The observations were conducted under such circumstances (i.e., clinically) that prolonged methods, involving the constant use of 3, 4, or more sets of bulky apparatus, such as is necessary in Kjeldahl's method, were more or less out of the question. The periods of examination were too brief to allow of the longer methods being carried out, and the space available for working them far too limited.

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As great care as possible was taken, however, to make the results as accurate as possible by rigidly adhering to the rules laid down by Dr Noël Paton¹ for use in the Hypobromite method of estimating Urea. They are as follows :-

(1) The same apparatus and same strength of Hypobromite solution to be always used, and first tested on a standard solution of Urea.

(2) The Hypobromite solution to be prepared freshly every day.

(3) The Urine, when concentrated, to be diluted till the specific gravity of between 1010 and 1020 is attained. 1020 was taken as a maximum specific gravity in these cases.

(4) Full time to be allowed for the temperature throughout the apparatus to become uniform before and after decomposition.

(5) The volume of the gas to be corrected for temperature and pressure.

(6) Throughout decomposition the temperature of the flask to be kept low by submerging it in a large basin of water at the temperature of the room.

The collection and storing of the Urine was carried out with the greatest care.

In no case was Glucose detected in the Urine.

In all cases where albumen was present for a/

1. Gibson & Russell. "Physical Diagnosis" p.258. 1902. Edin.

a longer or shorter period - in all but one of the cases - it was first removed by precipitating with Acetic Acid and filtering. The filtrate was taken and the Urea estimated from it.

We shall now proceed to a consideration of the cases on which experiments have been made. They are eleven in number and include cases occurring in males of ages from ten years to forty-three years. One case is that of a female.

An examination will first be conducted of the daily Urea excretion (twenty-four hourly periods) over the whole course of the disease, i.e. from as early a period as possible, till the time when the physical signs indicate that resolution is well on towards completion. Comparison will be made chiefly between the amount of Urea excretion and the temperature and diet, but also with the pulse, respirations, leucocyte count, and the quantity of Urine.

An investigation of the appearances seen in the four-hourly periods will then be made during the various periods of the fastigium, crisis, convalescence, etc., as regards the relation of the Urea and Urine to diet, temperature, pulse, respirations, leucocyte count, etc.

The results will be considered in two great periods:

(1)

- (1) During the Fastigium.
- (2) During Convalescence (i.e. from the time of crisis till the end of the period of observations.

In each and every case the following sequence will be adopted :-

- (a) A general statement of the history of the case.
- (b) The results of observations in the form of a chart of the case.
- (c) A consideration of the case in the different periods.
- (d) A summing up of the appearances as regards the Urea in each case.

The Thesis will be completed by a general Summary of the results of observations on the cases as a whole. Any points which appear to require explanation and have not been discussed previously will be considered under this head also.

CASE I.

CASE WITH DIMINISHED UREA DURING THE FASTIGIUM.

Gerald Stephen. 16 years. Admitted G. R. I.,
12/3/1907.

Illness began 11/3/07 with a rigor at about
3 p.m.

Symptoms :- Headache, anorexia, and sickness.
Vomited once. The same evening began to experience catching pain in thorax, low down in left side and in front; worse on coughing. Cough and tenacious sputum - not copious - and which became rust coloured next morning. Complained of shortness of breath. Sweated constantly, but never profusely. No marked critical sweating.

On day of admission, signs were those of consolidation of Left Lower Lobe, in about its lower half, extending from the posterior limit behind to mid-axillary line.

A fall of temperature began on the eighth day of illness. The true crisis occurred on ninth and tenth days. Resolution was rapid, so that only physical sign, on seventh day after completion of crisis, was an occasional redux crepitation heard over the lower half of Left Lower Lobe.

For diet, pulse, temperature, respirations and blood counts, see Chart.

The /

4 HOUR CHART.

DISEASE.

Pneumonia
Lower 1/2. L.L.L. lobe.

Name { Gerald
Stephen

Age 16 yrs

Diet see chart

Case Book No

Weight on adm. 8.6 lbs

Notes of Case

Onset 11.3.04
Rigor
Headache
Vomited
Cough & rusty spit
Shortness of breath
Pain in L. Chest-front & side

Sweating all along;
never profuse; not more
marked at crisis
No diarrhoea

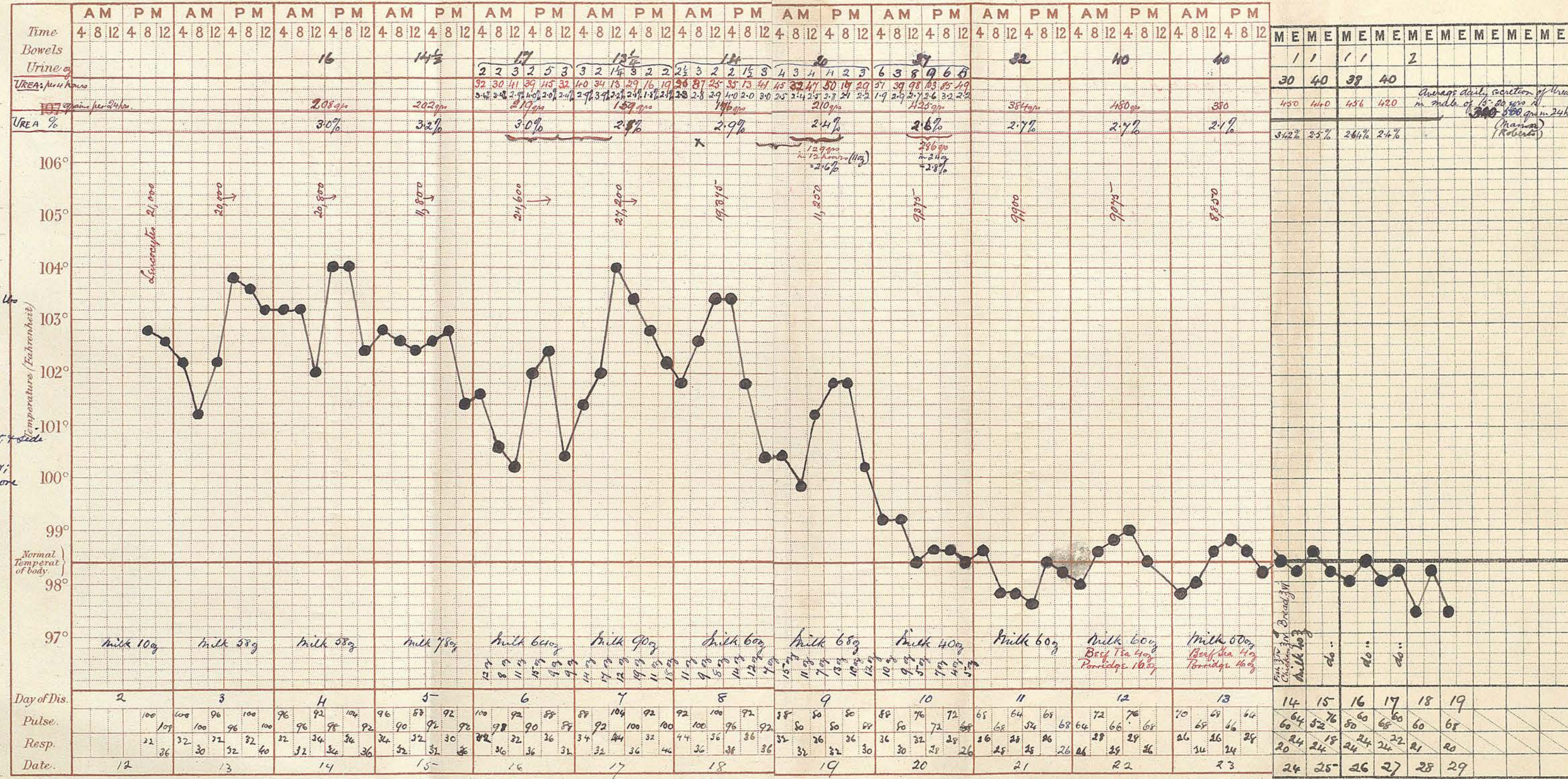
Albumen in urine till
7th day.

Resolution rapid

Date of admission

12.8.04

Result well



The consideration of this case :

(a) During Fastigium. Sweating was more or less constant, but never profuse. No diarrhœa. Sputum was never copious. So that probably a very small proportion only of the total Urea output was excreted in the sweat, stools, or sputum.

The average daily results, during the fastigium, for five days till the day of crisis, were :-

Total Urine	14.95 oz.
Total Urea	194 grains
Urea %	3.0%

Total Urine. The daily average Urine is markedly low (14.95 oz).

There are variations in quantity from day to day, which, however, are not so evident here as in most subsequent cases. No definite cause is apparent to account for these variations. An examination of the daily chart shews that they do not depend on the general average degree of the daily temperature and the four-hourly quantities give no certain indication of any relationship to temperature. The same absence of relationship is observed between the daily or four-hourly quantity /

quantity of Urine and the diet : on some days when the amount of milk imbibed (the only food taken) was much above the average, the total Urine was lower than average (e.g., seventh day); and vice versa.

A direct relationship is evident between the daily quantities of Urine and the Urea. This relationship is also evident in the four-hourly periods. The relationship is not at all proportional, however. This question will be discussed later under "total Urea." The Urea, as we shall see later, has a relationship to certain falls of temperature in the Fastigium, and this is seen also to some little extent in the Urine (in this respect see Note in Case III, Walter Semple). This is the only relationship apparent. It is not so evident as in the case of Urea, possibly because of the method of measurement (ounces) employed not registering such small quantities.

Total Urea. The total daily average Urea, for a patient of this age, is decidedly low in the fastigium.

Dr Dixon Mann¹ states the average Urea excretion, per 24 hours, in health, to be 0.4 to 0.6 of /

1. Phys. Path. etc. Urine, 1904, p. 131.

of a gramme per kilo of body weight in adults; and in children to be almost 1.0 gramme of the body weight. This youth's weight on admission was 8.st. 6 lbs. (which is nearly average for his age¹) and taking his average daily Urea excretion at from 0.4 to 0.7 grm. per kilo, we get roughly 340 grs. to 500 grs. Urea. Admitting that variations in total Urea in health are great, yet 194 grs. in 24 hours must be considered to represent a considerable reduction of total daily Urea from normal.

Relation to Temperature. The total daily Urea appears to bear no definite relation to the average daily temperature :-

	<u>Day.</u>	<u>Temp. Aver. for six 4-hr. periods.</u>	<u>Total Urea.</u>
i.e. on	4th Day.	103.1°	208 grs.
	5th Day.	102.4°	202 grs.
	6th Day.	101.1°	219 grs.
	7th Day.	102.6°	159 grs.

The only relation apparent is, that on days - such as the 6th and 8th - when the temperature shews a considerable fall below what may be considered the average height of the fever, there is an increase in the daily Urea output over the previous /

1. Roberts, Anthropometry.
Trèves, Physical Education.
Quetelet's Tables.

previous day. Apart from these special days, we are forced to the conclusion that there are variations in the total daily Urea excretion which cannot be accounted for (1) by the temperature, (2) by the diet. The second portion of the conclusion is apparent on comparison of the amount of milk taken and the Urea excreted in the daily and four-hourly periods.

The daily observations then, make it appear that there is no relation between the average daily temperature and the daily amount of Urea. An examination of the four-hourly notes on the Chart, gives a better idea of the relationship mentioned on the 6th and 8th days. This relationship is not at all one of degree. The association is simply between certain falls in temperature and an increase in Urea excretion. When the four-hourly temperature either remains more or less steady, or has very abrupt, small and brief oscillations, the four-hourly Urea appears to vary uncertainly with regard to the temperature; but at the termination of a more marked fall (about $1\frac{1}{2}^{\circ}$ or more) and extending over a period of 8 hours or more, there appears to be an increased excretion of Urea lasting for a period of 8 to 12 hours. Illustrations of this are seen on /

on the 6th, 8th, and 9th days at the completion of the falls of temperature seen on these days. These increases in Urea appear in some instances during the four-hourly period when the temperature touches its lowest point in the fall (e.g. on the 6th day), in others, they are first apparent in the next four-hourly period (e.g. 9th day). This apparent difference is due, probably, to the shortcomings of the four-hourly method of investigation, the temperature having probably touched its lowest earlier in the four-hourly period in some instances than in others, and the Urea increase accordingly being in full progress when the temperature was taken in the former instances, whereas in the latter it had hardly had time to begin. No relationship, direct or inverse, is evident between the degree of temperature and the amount of Urea in any period. No certain relation is observed between four-hourly rises of temperature and the amount of Urea excreted at the same time, but this question will be more fully discussed later.

On the 9th day, we are dealing with what is called a pseudo-crisis. Here, the fall in temperature is very considerable; and is critical in its /

its nature - though associated with none of the symptoms of the true crisis. At the completion of this fall, we have a sudden increased excretion of Urea such as I have spoken of. It is, however, relatively more marked than in the other two instances (6th and 8th days). It lasts for a more or less definite time, i.e., about 12 hours.

We shall see below that there is a similar sudden rise in Urea on completion of the true crisis.

Relation to Diet. There is no apparent relation between the amount of nitrogenous diet and Urea excretion either daily or four-hourly in the fastigium. On the day when nitrogenous intake is greatest (7th), the Urea is lowest, and on other days, there are apparently unassociated variations in the relative quantities of each. The four-hourly periods shew that an increased quantity of milk is not necessarily either associated with, or immediately followed by, an increased Urea output. This will be more fully discussed at a later period.

Relation to Urine. The amount of Urea appears to vary directly, though not proportionately, with the amount of Urine passed in the same period. This is well brought out in the four-hourly periods.

Whether /

Whether both of these associated increases or diminutions of Urine and Urea are due to a common cause, or whether either of them is the result of the other, I have been unable to ascertain. This question also will be further discussed in the General Summary at the end of the Thesis.

Highest Urea in Fastigium. In this case, the highest daily Urea noted is on the 6th day of illness. This is probably associated in a way with the lowered temperature, as I have suggested.

The increased Urine and Urea seen on the 9th day are due to a 'post-pseudo-critical rise' on that day.

General Course of Daily Urea Output. Although there appears to be, over all, a decrease in daily Urea output, as the Fastigium continues, it is not definitely proven. The Urea is not highest at the beginning here (as found in their cases by some Authors, e.g., Osler, Vierordt, etc.).

Urea Percentage. The average Urea percentage in health is 2.0 to 2.1 per cent.¹

The average percentage here is, therefore,
high - 3 per cent. - over the whole Fastigium,
and /

1. Kirke's Physiology (Halliburton) 1900 Edn.p.536.

and the degree of percentage is fairly constant, varying between 2.9 per cent. and 3.2 per cent.

The percentage does not appear to depend on the volume of Urine in any way, either daily or in the four-hourly periods. Nor does it appear to vary inversely as the amount of Urine or Urea either daily or four-hourly.

The only relation which the percentage appears to bear to the temperature is a general one. It is evident that while the temperature is well above normal in the Fastigium, the Urea percentage is high; but any definite relation between the Urea percentage and the degree of temperature is not evident, either daily or four-hourly.

(b) During Convalescence.

The Urine. The average daily Urine in health in a person of this age is between 40 and 45 oz.¹

There is here to be noted :-

- (1) A sudden increase in total quantity of Urine on the day of Crisis. This increase is seen on examining the four-hourly notes to be almost entirely the result of a post-critical increase in Urine /

1. Thomson "Clin. Exam. Sick Children", p. 92.

Urine which lasts from 8 to 12 hours.

- (2) There is a fall away in the total quantity of Urine on the second day of convalescence, but the rise to near normal occurs almost immediately after, i.e., 3rd day of convalescence.

- (3) From that time forward, it oscillates to and fro about the normal. The increase on the 3rd day of convalescence occurs synchronously with a change in diet.

The Urea. Only more striking than the sudden increase in the quantity of Urine at the completion of the Crisis, is the great increase in Urea. The total Urea for the period of 12 hours immediately following the completion of the Crisis, is more than double the quantity excreted in the 12 hours preceding that. This post-critical rise, we shall see again almost invariably in other cases.

After the post-critical rise, there is a fall in the Urea output again on the 11th day of illness. The quantity, however, is much higher than that recorded at any time during the Fever. From that time onwards it increases towards normal.

On /

On the 12th day after onset of illness, a change in diet was made. Sixteen ounces of porridge and four ounces beef tea were added, while the amount of milk taken was the same as before. Coincident with this change, there is a sudden upward jump in the quantity of Urea. Indeed the amount noted is the highest on the whole Chart for a similar period. There is a return to a lower level on the following day. This phenomenon is of very frequent occurrence and will be observed again in other cases always associated with a sudden marked change to a more liberal diet in convalescence. It looks as though the equilibrium were disturbed for the nonce by this sudden change, but that the body, accustoming itself rapidly to the altered circumstances, is found within 24 hours or so back to much the same condition as before the change; the Urea having returned to a level which suggests a more gradual return to normal.

On the 14th day again, there is a similar appearance to that seen on the 12th. It is synchronous with the addition of chicken, fish, and bread to the diet. There is a slight fall again in the Urea output the following day. The return of the total daily Urea excretion to about normal probably takes /

takes the form of a gradual increase, which may be considered more or less complete on the 15th or 16th days. The probable more or less steady nature of the increase is obscured here by the irregularities in amount of Urea associated with alterations in diet.

The Urea Percentage. The Urea Percentage at the time of the post-critical rise is decreased (2.8 per cent.) in comparison with the percentage during the fastigium, but it is higher than on the preceding day, and is still much above normal.

It remains above normal, though shewing a decrease over all, from this time onwards. It had not returned to normal when observations ceased.

The sustenance of the percentage at 2.7 per cent. on the 12th day may be due to the change of diet on that day - at any rate, when equilibrium is re-established on the following day, there is a marked fall.

On the 14th day, the Urea percentage is abnormally high. This is synchronous with the addition to the diet of fish, chicken and bread. The explanation of this increase is probably the same as that for the 12th day, and as the cause of the rise /

rise in Urea on these days. There is a slight fall again in percentage on the 15th day. The return towards normal shews curious oscillations in the daily amount with on the whole a downward trend towards normal.

Resolution. The process of resolution would appear to have kept pace more or less with the return of the Urea to normal. Resolution progressed rapidly here, and by the 7th day after the completion of the Crisis, the only physical sign was an occasional redux crepitation heard over the lower half L.L.L.

The Urine in this case contained albumen in gradually decreasing quantity till the 7th day of illness. The question as to whether the unhealthy¹ condition of the kidneys, which this appearance probably indicates, has an influence on the quantity of Urea excreted, will be discussed in the General Summary.

Considering the Urea in this case then, we observe that :-

(1) Urea excretion is low during the fastigium from the earliest note till the Crisis.

(2) /

1. (Cloudy Swelling in the cells of convoluted tubules.)

(2) The diminution does not consist of an increasing decline from first to last. The decline is less on the 6th day than on the two days previous. After the 6th day the decline is more marked than at any previous period. It is possible that, had the temperature been more regular, a gradual decline towards the Crisis might have been seen.

(3) A temporary increase in Urea excretion after some of the more marked falls in temperature e.g., the 6th and 8th days, the increase lasting for 8 to 12 hours takes place, and, -

(4) A greatly increased excretion of Urea temporarily following immediately on Crisis - the post-critical rise. It lasts from 8 to 12 hours.

(5) There is then again a fall; and after that a more or less gradual increase towards normal.

The Leucocytes, beyond shewing a fall closely associated with the pseudo-crisis and the true crisis in temperature, cannot be shewn to be definitely associated with the amount of Urea.

The pulse remains high, while the temperature is so, and is closely associated with its fall. Its variations /

variations, however, are not proportional to those of the temperature, nor does it always follow the course of the temperature closely during the Fastigium. The relation which the pulse bears to the amount of Ur̄ea excretion is, however, very much that of the temperature.

The same may be said of the respirations during the fastigium. Their return to about normal is much tardier than pulse and temperature. It does not return absolutely to normal during the period of observation. In its return, it apparently keeps pace more or less with the process of resolution and the return of Urea to normal.

4 HOUR CHART.

DISEASE.

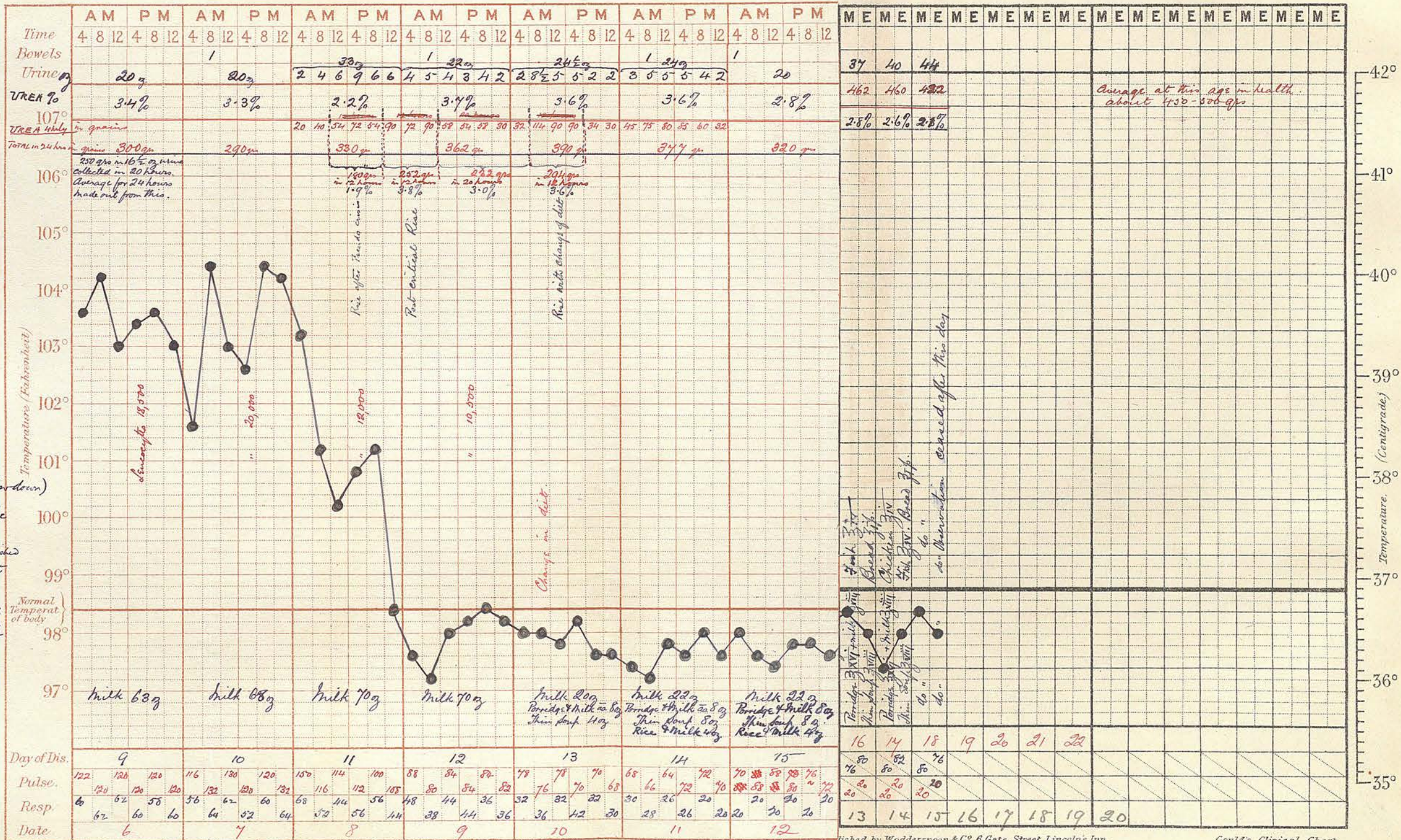
Name { Joseph
Biondi
Age 23 years.
Diet (see chart)
Case Book No

Notes of Case

Pneumonia R. L. Lobe.
Onset 29.3.1904
Rigor
Headache
Anorexia
Cough & Sput
Pain in rt chest (front, lower)
Trace of albumen in urine
on day of admission.
Amount gradually diminished
daily, till 12th day; absent
on 13th day.
Sweated moderately all
along he says. Considerable
sweating at crisis.
Resolution very rapid

Date of admission
6.4.09

Result well



CASE II. ANOTHER CASE WITH DIMINISHED UREA DURING THE FASTIGIUM.

Joseph Biondi. 23 years. Admitted G. R. I.
12/3/07.

Illness began 29/3/07 with rigor at about
4 p.m.

Symptoms:- Headache, and anorexia, but no vomiting. Cough and a tenacious spit. The same evening began to have stitching pain in the right side of the chest about 6th costo-chondral articulation in front. Worse on coughing. Felt very short of breath.

On admission physical signs indicated consolidation of whole Right Lower Lobe. No diarrhoea during illness. Sputum never copious. Sweated a little all through illness till Crisis, when profuse sweating began and lasted about 24 hours (from 12 p.m. 7/4/07 till about 12 p.m. 8/4/07).

The temperature was high for pneumonia till the Crisis, which occurred on the 10th and 11th days. The fall of temperature at the Crisis was not continuous, but shewed an oscillation of some 12 hours' duration in the middle of the fall.

Resolution proceeded rapidly and by the 7th day after Crisis the only abnormal physical signs were some redux crepitations over the lower part R.L.L. posteriorly.

There was a trace of albumen in the Urine on the day of admission. It diminished gradually in amount each day, and was absent on the 2nd day after the completion of the Crisis.

The Consideration of this Case. This case bears a close general resemblance to Case I, differing only in minor particulars.

We have no more reason to suspect here than in Case I, that any very considerable proportion of the total Urea excreted left the body by any other /

other channel than the urinary passages.

A start was made in collecting the Urine at 4 a.m. on the 6th of April - the 9th day of illness. From that time till the following midnight (20 hours) $16\frac{1}{2}$ oz. Urine were collected, containing 250 grs. of Urea. To make up an average complete day, these amounts were corrected proportionately for the extra 4 hours, i.e., the total was divided into fifths, and an extra fifth added to both Urine and Urea. This gives an average 24 hours, which is unlikely to be far out from the real total for that whole day. The Urine was not collected 4-hourly till 4.a.m. on the 11th day of illness.

(a) During the Fastigium. This allows us to consider a total daily average for 2 days till the Crisis.

The results are :-

Total Urine	20 oz.
Total Urea	295 grs.
Urea %	3.35 %

Total Urine. Whatever the amount may have been earlier in the Fastigium, the average is decidedly low over these two days (20 oz.). The average in health /

health of a man of this age is about 50 oz. The Fastigial period is too brief here to allow of a useful comparison being made between amount of Urine and daily average temperature. The relationship here, however, is very constant so far as it goes.

No evident relationship exists between the amount of Urea and the diet.

Unfortunately no four-hourly specimens were tested till the day of the Crisis.

Total Urea. The daily average Urea excretion here (295 grs.) is also low for a patient of this age, whatever it may have been earlier in the Fastigium.

There is a slight decline in the daily output towards the Crisis. It appears to be independent of the amount of food taken. There are not sufficient grounds for any statement regarding its relation to temperature.

Its relation to the amount of Urine is fairly close so far as our opportunities allow us to investigate.

Urea Percentage. The average percentage here is high (3.35%). The percentage is very constant, varying from 3.4% to 3.3%.

It /

It does not appear to depend on the volume of the Urine. It does not vary inversely as the amount of Urine, but rather, if anything, directly with the amount of Urea.

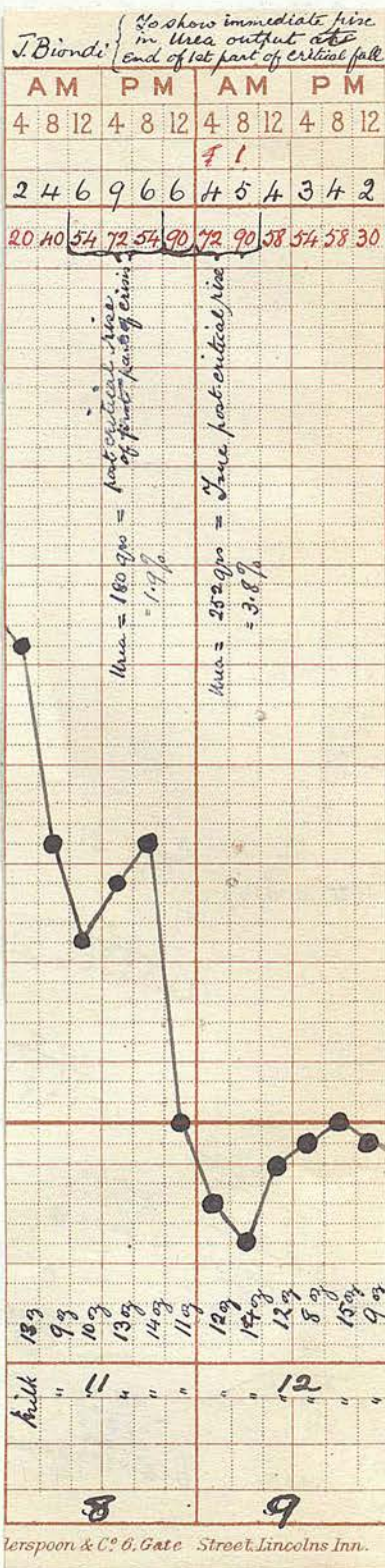
It appears to bear no ratio to the amount of nourishment taken.

Here again, the only obvious relation between Urea percentage and temperature is that, while temperature is up in the Fastigium, the percentage is above normal.

The appearances observed on the 11th day of illness will be considered along with convalescence.

During Convalescence. We are here at liberty to consider appearances both daily and four-hourly.

The Urea. The rise in Urea (and Urine), which was seen to occur in the previous Case with the termination of the Fastigium, hardly, at first sight, appears to be purely post-critical here. On examining the Chart we see a marked rise in Urea (and Urine) on the day when the temperature is falling, and before the fall is complete. This appearance is at first difficult to understand, but the explanation is really similar to that given in the last Case to /



to explain the increases in Urea on the 6th, 8th and 9th days. An examination of the four-hourly Chart here will throw light on the subject.

Before proceeding further, let us observe that we have here what, for want of a better term, we may call "a broken crisis" (in reality, the first part is very similar to the pseudo-crisis seen in Cases I and VI). The temperature falls in a critical manner from 104.2° to 100.2° . There then begins an upward trend to 101.2° . This upward trend lasts approximately for 12 hours. From this point the temperature falls by crisis to normal or below.

Now in cases with this type of crisis, the seemingly epicritical nature of the rise in Urea (and Urine) is a very usual feature.

The first part of the crisis here (i.e., till 8 p.m. on 11th day of illness) is, in fact, similar in appearance and results (as regards Urine and Urea) to the pseudo-crises we see in Case I and Case VI; only differing in its much closer proximity to the final fall of temperature.

The cessation of the first part of the fall in temperature (104.2° to 100.2°) is immediately followed by a sudden and well marked increase in Urea output /

output, lasting about 8 to 12 hours. This occurrence is similar in appearance to those seen on 6th, 8th and 9th days in Case I, and to the post-critical rise in Urea on the 10th day in that case; and also to the post-critical rise which almost immediately follows in this Case.

The post-critical rise in Urea follows so closely on this rise (beginning 8 - 12 p.m.) that there is no time for an intervening fall in Urea output to occur, and the two increases are in direct continuity.

The seeming anomaly here, then, is not really such, and the gradual daily increase in the total Urea output seen on the 11th and 12th days after the onset of illness is really due to a cumulation of the results of two distinct temporary increases, the increase following the break in the Crisis being smaller than that following the completion of the Crisis.

Two quite different reasons might be put forward to explain these temporary increases in Urea output (seen here and in Cases I and VI) occurring before the true post-critical rise.

(1) That the increase in Urea is of the same nature as the true post-critical rise, - i.e., that it /

it is a result of the fall in temperature - for a marked and considerable fall by Crisis is seen here (104.2° to 100.2°) and also in Case I. These falls bear a resemblance to the true abrupt and complete Crisis which ends the fastigial period of a typical Case of Lobar Pneumonia, differing, of course, in the fact that they do not reach normal, and are not accompanied by the alteration in the patient's whole condition, which occurs with a complete Crisis in uncomplicated cases.

If this view is accepted, it can readily be believed that these precritical falls in temperature are followed by a temporary increase in Urea excretion, just as the true Crisis is.

(2) Against this view the alternative explanation is that the temporary increase in Urea is really the result of the temporary rise in temperature, which here and elsewhere (Cases I and VI) is seen to succeed the fall.

On examination of the four-hourly notes of the Urea totals in this and other cases (e.g. Cases I, III, and VI), we frequently see a rise of temperature occurring synchronously with an increase in Urea output. But this appearance is seen almost invariably to occur in cases where the rise in temperature succeeds a fall of temperature of the nature we have been /

been discussing in this case, and on 6th, 8th, and 9th days in Case I.

Again there are other instances in these cases where a rise of temperature is synchronous with a fall in Urea output and vice versa.

These latter observations, together with the resemblance of the falls in temperature quoted, to a true crisis (when there is, as a rule, no subsequent rise of temperature, and which is invariably followed by a similar increase in Urea and Urine lasting a similar time); also the fact that the increase appears to last a more or less definite period, irrespective of how long or brief the succeeding rise of temperature is; and also the fact that these rises in Urea output are usually associated with an increase of Urine (see here and in Cases I and III) as with a true post-critical rise, while if due to increase of temperature only, we should expect a decrease in Urine (Urine usually reduced in fever); all these facts incline me to the belief that Reason (1) is more likely to be the true one; or at any rate, the more important one. The probability of any relationship between Urea excretion and temperature in the four-hourly periods will be discussed /

discussed in a separate consideration of the four-hourly relation of Urea to temperature, etc. which will be undertaken later.

That the amount of nitrogenous intake is not the cause of these temporary increases in Urea excretion is evident from a study of the small four-hourly Chart of two days' duration, which is appended.

Post-Critical Rise in Total Urea. A further consideration of the four-hourly notes on the Chart shews :-

That the true post-critical rise began when the temperature touched normal between 8 p.m. and 12 p.m. on 11th day after onset of illness. The increase was marked for about 12 hours following. During that period 252 grs. Urea were excreted in 16 oz. Urine.

During the period of the post-critical rise, the temperature fell very low. It rose again about the end of the period of the post-critical Urea increase.

The post-critical rise in Urea was followed by a very decided fall in Urea output till about 4.a.m. on 13th day. In this period of about 20 hours, the Urea output is subnormal (232 grs. in 20 hours).

During /

During the next four-hourly period (i.e., about 7 a.m.) a change of diet was made. This change consisted in the addition of thin soup 4 oz., and porridge 8 oz., to the diet, though the milk given this day was much less than on the previous day. Immediately we see (as in Case I), a great upward jump in the total amount of Urea. Indeed, for the 9-10 hours following, the total Urea output was 292 grs. in $18\frac{1}{2}$ oz. Urine. The duration of this increase was between 8 and 12 hours; a similar period to that observed elsewhere, when the nitrogenous equilibrium seemed to have been suddenly disturbed.

Following this rise, the Urea output falls again to a little above the level it assumed immediately after the termination of the post-critical rise. This rapid re-establishment of equilibrium is seen in other similar instances.

From this period, the total Urea quantity shews a tendency to oscillate - with a slight gradual upward trend - till the 16th day after the onset of illness. On this day again, we observe a similar appearance to that seen on the 13th day. The addition of Fish and Bread to the diet is associated with a marked increase in Urea output for the day. The increase is maintained on the following day, probably due to the further addition of Chicken to the diet.

The /

The 18th day brought no further change in diet, and there is a fall again in total daily Urea (but not to such a low level as before the equilibrium was disturbed). These appearances are in accordance with previous observations of the results of change of diet in other instances.

Further observation of this Case was unavoidably terminated at this point, and the fact is regrettable, as the additions to the diet on the 16th and 17th days obscured a further study of the appearances to be observed in the return of the daily Urea output to normal.

But as resolution was very far advanced at this time (judging by the paucity of physical signs), and - as I hope to shew in other cases - the rate of return of the daily Urea output to about normal appears to keep pace, more or less, with the rapidity of the process of resolution in each case, the probability is that there was no further marked or sustained fall away from the line of more or less gradual increase towards normal.

The Urine. There is a marked increase in the amount of Urine on the 11th day after the onset of illness - the day of the break in the Crisis (see four-hour Chart). This increase is in intimate association /

association with the increase in Urea excretion at this time, and begins at the termination of fall in temperature from 104.2° to 100.2° on the first half of the 11th day.

The amount of Urine passed at the time of the true post-critical rise in Urea is greater (15 oz.) than for any similar period during the fastigium, so far as our observation of that period allows us to note.

On the subsidence of the post-critical rise, there is again a fall away in the quantity of Urine, lasting till the period between 4 and 8 a.m. on 13th day, when there is again an increase in association with the increase in Urea (due to the altered diet). From that time onwards, there is a fall in the daily total Urine until the 16th day, when there is a very marked rise. This increase is again associated with a great increase in the total daily Urea excretion, and probably again is in some way affected by the change in diet on that day. From that day till observations ceased, there is a steady increase in Urine quantity towards normal.

It appears, therefore, that during convalescence the amount of Urine and Urea for the same periods vary /

vary directly with one another. The relative variations are not at all proportional, however.

The Urea Percentage. The Urea percentage is low (1.9%) after the completion of the first part of the fall in temperature on 11th day - and while the increase in Urine and Urea is in progress. This appearance is similar to that seen for 12 hours after the pseudo-crisis on 9th day in Case I (q. cf.). With the post-critical rise in Urea, the percentage increases again to 3.8% for the 12 hours. This percentage is the highest noted at any time in the Case.

From the completion of the period of post-critical rise, the percentage falls relatively - though still actually above normal (3.0%) - till the change of diet on 13th day, when there is again an increase to 3.6%.

From this point onwards, there is a decline in percentage (till observations cease), though the sustained percentage on the 16th and 17th days, compared with the great fall in percentage on the preceding day, suggests that the change in diet in these two days has again influenced the percentage. On the 18th day, when further change in diet ceases and equilibrium tends to be restored, there is a marked fall in percentage (i.e. from 2.6% to 2.1%).

The /

The Urea percentage, so far as we have been able to observe it in convalescence, then, has always been high.

Neither here nor in most other cases does the course of Urea percentage resemble the course of the total Urea by shewing usually a fall to sub-normal for a brief time at beginning of convalescence, and then a more or less gradual rise to about normal. It appears to fall gradually and continuously to normal.

No oscillations in percentage are visible on the daily Chart in convalescence, but the four-hourly Chart (to be considered later in the special discussion of the four-hourly periods) shews markedly these oscillations around the average line of descent to normal.

To sum up regarding the Urea then in this

Case :-

- (1) Urea Excretion is low during Fastigium from the earliest note to the Crisis.
- (2) There is a tendency to a decline in total Urea from the earliest note till critical fall begins.
- (3) A temporarily increased excretion of Urea, immediately following the 'break' in the Crisis, and lasting for 8 - 12 hours.
- (4) /

- (4) Another temporarily increased excretion of Urea immediately following the completion of the true Crisis - the post-critical rise. It also lasts about 12 hours, and is greater in amount than the rise noted under head (3).
- (5) There is then again a fall in total Urea for a brief period; and after that an increase towards normal, the daily amount being increased on some days in association with dietary changes.
-

The Leucocytes shew a less abrupt fall than usual at time of Crisis. This may depend upon the 'break' in the Crisis.

The Leucocyte counts shew no apparent relation to the amount of Urea other than that due to their relation to the temperature.

Pulse and Respirations. The same appearances are noted here as in Case I. The respirations first touch 20 per minute late on the third day after Crisis is complete. They cannot be said to be quite normal when the record of observations ceases. Here again, therefore, we note that the respirations to a great extent keep pace with process of resolution, and the return of the daily Urea to normal.

Daily, 12 hourly, & 4 hourly Chart.

Pneumonia
LLL (lower $\frac{2}{3}$ rds)

Age 14 years

Diet suchant.

Case Book No. *Weight on ad. 6st, 8 $\frac{3}{4}$ lbs.*

Notes of Case

Onset 24.3.1904

Rigor
Headache
Anorexia & Vomiting
Cough
Great Breathlessness
Pain in L. Chest and Epigastrium

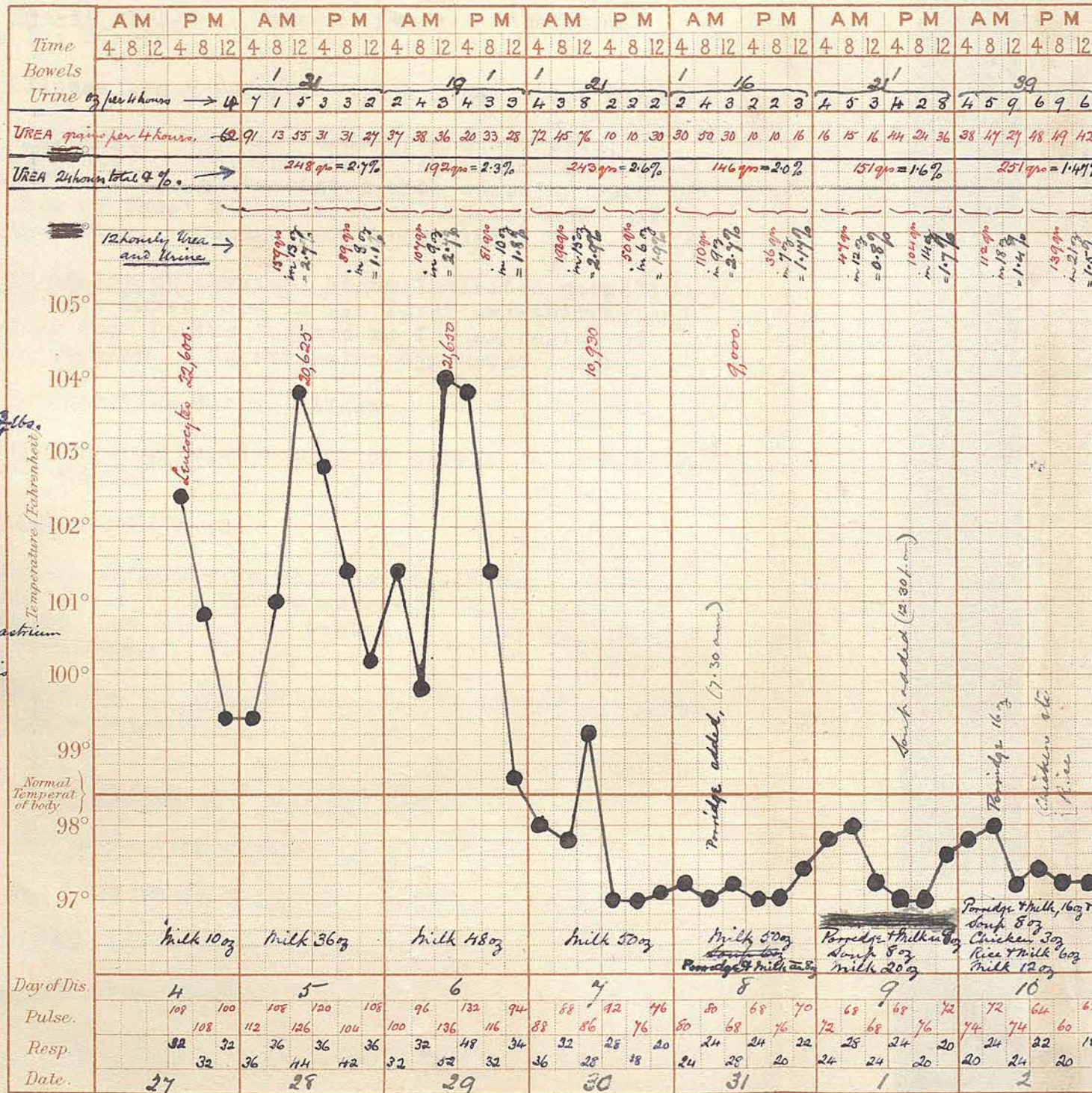
Some sweating at Crisis
tho' not marked.

Non alcoholic
Never albumen in urine
Resolution rapid

Date of admission

27. 3. 1904

Result well.



MEMEMEMEMEME						MEMEMEMEMEME					
002	10	100	10								
33	40	57	44	50							
251	520	342	352	450 = Total Urea		Average Urea Excretion per 24 hours in male of 12-16 yrs of average height is about 300-450 gms. (Harris Mann Mayer & Guther)					
1.6%	1.82%	1.37%	1.82%	2.03% = Urea %							
Observations ceased.											
<p>Detailed description: The graph shows a fluctuating trend. On April 11, there's a point at ~40 labeled 'diet as yesterday'. On April 12, two points at ~60 and ~40 labeled 'dight diet'. On April 15, a point at ~60 labeled 'Small Crabs given'. On April 16, a point at ~40. There are also unlabeled points at approximately 68, 64, 60, 74, and 56.</p>											
11	12	April		15	16						
68	64	68	64	60	60						
20	22	20	20	20	18						
3	4	5	6	4	8						
				9							

CASE III. CASE with DIMINISHED UREA during FASTIGIUM in a BOY
aged 14 years. :

Walter Semple. Aged 14 years. Admitted
 G. R. I., 27/3/07.

Illness began 24/3/07 with a rigor about midday.

Symptoms. General headache and anorexia;
 vomited (once). Painful cough began same day. No
 sputum then. Soon associated with catching pain in
 Left side of Chest below level of nipple, and also
 in epigastrium. Became very breathless.

On Admission physical signs indicated consolida-
 tion of Left Lower Lobe in its lower two-thirds, and
 extending from behind forward as far as region of
 cardiac impulse. No extension was noted later.

No diarrhoea during illness.

No sweating noted except at Crisis - and then
 not very marked.

Sputum swallowed.

Crisis complete on morning of 7th day. Resolu-
 tion was rapid. A few redux creps. only, heard
 over lower part of L.L.L., behind, on 15th day after
 onset of illness.

There was no albumen detected in the Urine during
 period of residence.

The Consideration of this Case.

Considering the absence of marked sweating,
 diarrhoea, and copious sputum, we have no reason to
 believe that there was a considerable Urea excre-
 tion by any other channel than the Urine.

(a) /

(a) During the Fastigium.

The average daily results for two days till the completion of Crisis were :-

Total Urine	20 oz.
Total Urea	220 grs.
Urea Percentage	2.5%.

Total Urine. Holt¹ states the average daily Urine, in children between 8 and 14 years, at 32 - 48 oz. In this case, therefore, we must consider the daily average Urine in the Fastigium (20 oz.) to represent a considerable reduction.

Here, again, we see the daily variations in quantity pointed out in Cases I and II.

As regards relation to temperature, it might be argued that here there is a suggestion of an inverse ratio between the daily total Urine output and the average degree of daily temperature on the two days of the Fastigium, i.e.,

	<u>Urine.</u>	<u>Aver.temp.</u>
5th day	21 oz.	101.43°
6th day	19 oz.	101.46°

but in the four-hourly periods, we observe no such relationship /

1. Thomson "Clin. Exam. Sick Children", p. 92.

relationship, i.e.,

		<u>Urine</u>	<u>Temp.</u>
5th day.	4 a.m.	7 oz.	99.4°
	8 a.m.	1 oz.	101.0°
	12 a.m.	5 oz.	103.8°
	4 a.m.	3 oz.	102.8°
	8 a.m.	3 oz.	101.4°
	12 a.m.	2 oz.	100.2°

A similar absence of relationship is seen on 6th day.

The amount of Urine, therefore, does not appear to vary either directly or inversely as the temperature.

There is usually a temporary increase in Urine, as in Urea, following the termination of a more or less marked fall of temperature below the average height of the Fever in the Fastigium, e.g., 12 p.m. to 12 a.m. on 4th and 5th days, and 8 a.m. to 4 p.m. on 6th day of illness. This is the only apparent relationship, and resembles the Urea relationship (which see later). It does not appear to be so definite or constant, however, as in the case of the Urea, possibly because the unit of measurement for the Urine (the ounce) is much larger than the Urea /

Urea unit (the grain), and therefore does not shew the differences so well. There is an obvious lack of relationship between the total daily amount of Urine and the amount of diet. On the 6th day of illness, with an increase, compared with previous day, of 12 oz. fluid food, there is a reduction of 2 oz. in total amount of Urine.

There is here, again, a direct, though not proportionate, relationship, between the variations in amount of Urea and Urine both in the daily and four-hourly totals.

Total Urea. The average daily Urea output (220 grs.) in the fastigium represents a decrease from normal. The daily average in a patient of this age (14 years) and weight (6 st. 8 $\frac{3}{4}$ lbs.), (worked out from the statement of Dixon Mann already quoted, Case I, and the anthropometric tables of Roberts, Trèves, and Quetelet) should be between 330 and 360 grs.

Relation to Temperature. In this case also the total daily Urea appears to bear no definite relation to average daily temperature, e.g.

	<u>Daily Urea.</u>	<u>Av. daily temp.</u>
5th day	248 grs.	101.43°
6th day	192 grs.	101.46°

Though the comparative amounts on the two days shew an inverse relation to the temperatures, yet it is inconceivable that the $\frac{3^{th}}{100}$ of one degree of temperature should be responsible for a difference of 56 grs. Urea, with such a small average daily output.

As in the previous Cases, the only relation visible between Urea excretion and temperature is an increase in the Urea output on the completion of a considerable fall of temperature. In the Fastigium here, the temperature is very irregular for some reason, and the appearance I speak of is well demonstrated.

For 16 hours from the end of the first marked fall of temperature noted, i.e., at 12 p.m. on 4th day of illness, there is an excretion of Urea which is markedly greater than the 16-hourly average for the whole Fastigium.

Again, an increase is observed covering the first 12 hours of the 6th day. This increase does not appear till the four-hourly period following the termination of the marked fall in temperature immediately preceding, but the probable explanation of this appearance has been given in Case I, under "Total Urea."

The /

The Urea excretion is much lower on the latter halves of the 5th and 6th days of the Fastigium, when the temporary Urea increases have passed off. There is no further increase till the post-critical rise appears.

The question, as to whether these increases in Urea excretion are due to the falls, or subsequent rises, of temperature, has been discussed in Case I, and will be referred to again later.

This, then, is the only apparent relationship here between the temperature and the Urea excretion.

There are here, as in other cases, in the Fastigium, variations in the four-hourly Urea quantities at various times, which cannot be accounted for by the degree of temperature either directly or inversely.

Relation to Diet. In regard to diet, the quantities of milk given in the four-hourly periods were unfortunately not noted in this case. (We saw in Cases I and II, however, that there is no apparent ratio between diet and Urea in fastigium, and considering daily differences here, it is probable that four-hourly notes would also have failed to shew a definite relationship).

The relation to the Urine has already been noted.

Highest /

Highest Urea in the Fastigium. The period during which it is possible to observe the Fastigium is too brief to allow of any proper comparison being made.

There is a decline in daily Urea output in the direction of the Crisis during the period under observation.

Urea Percentage. The daily average Urea percentage, though above normal, is not markedly high (2.6%). For the short period we have to judge from, the daily percentage is fairly constant, - 2.7% and 2.3%. The percentages for the shorter periods, however, vary greatly at different times.

The percentage does not appear to depend on the volume of the Urine in any way, nor does it appear to vary inversely as the amount of Urine or Urea.

Here, again, the only apparent relation between percentage and temperature is a general one, viz., that the Fastigium is associated with a Urea percentage above normal.

(b) During Convalescence.

The Urea. A very marked rise in Urea excretion occurs on the day when the Crisis is complete (7th day). This increase is first evident /

evident immediately after the temperature has fallen below the normal line, that is between 12 p.m. on 6th day and 4 a.m. on 7th day. The increase lasts about 12 hours (see 4-hourly notes on Chart), and during that period, total excretion amounts to 193 grs. Thus we see that the Urea excreted during this post-critical rise, and extending over 12 hours only, is greater than the whole 24 hours' excretion of the previous day.

The total for the whole 24 hours on the 7th day is 243 grs., representing an increase of 51 grs. over the total for 6th day. This increase cannot be ascribed wholly to the slight increase in nitrogenous intake on that day. This increase in diet amounts only to 2 oz. of milk. Now Dr Haig¹ gives as a working hypothesis that the albumens necessary to produce a given quantity of Urea can be found in grains by multiplying the given number of grains of Urea by 3. To account for the increase of 51 grs. of Urea here, then, 153 extra grains of albumens would have to be taken and absorbed; but taking the amount of albumens in the milk at 3% (about correct, as I have shewn), this would involve the absorption of rather more than 10 oz. of extra milk, whereas patient only had 2 oz. The question of the cause of /

- - - - -

1. "Diet and Food", p.6.

of the post-critical rise in Urea will be discussed in a consideration of our general conclusions, which will be undertaken towards the end of the Thesis.

In this case again, there is a marked fall in Urea excretion after the post-critical rise is completed. The quantity for the 12 hours following the completion of the post-critical rise is much lower than for any similar period previously. From this time the gradual rise in quantity of the total daily Urea in its return to about normal, is well marked, there being only one downward oscillation. This occurs on 11th day after the onset of illness, and is probably the result of the reaction following the great upward jump in the total Urea quantity on the previous day, which is associated, as in other cases, with the addition of Chicken and Rice to the diet.

This increase is partly due to the increase in Urea consequent on the addition of 8 oz. Porridge at 7 a.m., but chiefly to the increase following the midday meal of Rice, Chicken, etc., about 12.30 p.m.

No marked daily increase is observed here on the addition of Porridge to the diet. But there is an increase in the four-hourly period between 4 a.m. and 8 a.m. on 8th day, in which period the Porridge /

Porridge was first given (about 7 a.m.), and again in morning and afternoon of 10th day, shewing a close association with additions to diet.

Again, we see a marked daily increase on the 12th day, when patient is put on light diet, which involves simply increased amounts of what he has been having for previous two days. The upward trend in daily excretion continues, and again on 15th day after onset, we see another great upward jump associated with the addition of a chop to the diet. Four-hourly observations ceased on the 10th day at midnight.

Though the return of Urea to normal here seems very steady and without oscillation, so far as the total daily excretion is considered, the 12-hourly and 4-hourly periods shew varying oscillations in quantity for as long a period as we are able to observe them.

It is noteworthy here (as is seen in other cases), that temperature is low during the post-critical rise, and rises somewhat at its termination.

The rate of the process of resolution here again appears to keep pace more or less with return of Urea and respirations to about normal, resolution being apparently almost complete, judging by physical signs, when observation ceased.

The /

The temperature can hardly be considered to have returned to normal when observations ceased.

The Urine. Here again, we note as in previous cases :-

(1) A sudden post-critical rise in the quantity of Urine, which is closely associated with the increase in Urea.

(2) A fall away in total quantity of Urine, following this increase, and most marked in the 12 hours immediately succeeding completion of the post-critical rise. It amounts during this period to 6 oz., as compared to 15 oz. in previous 12 hours. Taking the average daily quantity in health for a boy of this age and weight, at from 40-50 oz., it is apparent that there is here a considerable reduction below normal.

(3) From this time onwards a more or less gradual increase towards normal, with no daily oscillation till the 11th day after onset, when it falls somewhat in association with the fall in Urea after the disturbance of nitrogenous equilibrium on previous day. There is a marked increase on the 10th day, when, as we have seen, the Urea is increased also in association with a dietary change.

From /

From this day onward, the daily amount oscillates, now higher, now lower, but always on the upward trend. Indeed, if we consider 45 oz., or thereabouts, a likely daily average in health at this age, we may consider that these oscillations are a feature of the return of Urine to normal.

(4) Though there are no oscillations apparent in daily quantities of Urine in the earlier days of convalescence, these are evident in the four-hourly and twelve-hourly totals for so long as it is possible to observe them.

The Urea Percentage. Here we observe :-

(1) A high percentage (2.9%) over 12 hours of post-critical increase in Urea and Urine.

(2) A marked fall (to 1.9%) in the immediately succeeding period of 12 hours. It is below normal here in this period.

(3) The following 12 hours (i.e., first half of 8th day), there is an increase to 2.7%. There is noted an addition of Porridge to the diet between 4 and 8 a.m. in this period, and the increased percentage is partly contemporary with this.

(4) /

(4) There is a downward decline for 24 hours following 12 a.m. on the 8th day.

(5) From then onwards, there is a gradual increase in percentage, with occasional 12-hourly and daily oscillations, but frequent 4-hourly oscillations to about normal on the 15th day. The most marked increases in this latter period are on days (or shorter periods) when a change of diet was made, but on one occasion (the first half of 10th day), some increase in diet is associated with a relatively reduced 12-hourly percentage, though this does not apply to the 4-hourly period in which the increase in diet was given. The other fall in percentage is on the 13th day, and is associated with a very large excretion of Urine. There was a dietary increase on previous day.

There is seen, then, in this Case, a low percentage during Convalescence, an appearance differing from those seen in Cases I and II (q.v.).

The Urine did not contain Albumen at any period of observation.

Considering the Urea in this Case, then, we observe :-

(1) /

(I) The Urea excretion low during Fastigium from the earliest note to the Crisis.

(II) The total daily excretion shows a decline in direction of Crisis.

(III) The twelve-hourly and four-hourly totals show variations during Fastigium, some of which are apparently associated with certain temperature changes.

(IV) A marked post-critical rise in Urea output, apparently beginning immediately the Crisis is complete, and lasting for about 12 hours.

(V) Then, again, a fall in Urea output more gradual and prolonged than in Case I; lasting about 48 hours; and after that a more or less gradual increase towards normal.

The Leucocytes. The relationship to temperature, Urea output, etc., in this Case is similar to that seen in Case I.

Pulse and Respirations. The above note also applies to the Pulse and Respirations. The lack of intimate relationship between the variations of pulse and temperature, and the respirations and temperature /

temperature is again obvious here. The relation of pulse and respirations to the Crisis is similar to that seen there¹, and the conclusions stated regarding the question of their relationship to the Urea excretion are observed to apply in this Case also.

1. (i.e. in Case I).

4 HOUR CHART.

DISEASE.

Pneumonia RUL (stab)
+ R.L. Apex (upper 2 ins)

Name { William
In Lean

Age 10 years

Diet see chart.

Case Book N°

Notes of Case

(For history see Notes
of Case.)

No Sputum got.

Albumen in Urine:—

Cloud on day of admission

" " 7th day of illness.

trace " 8th " "

" " 9th " "

fine trace " 10th " "

absent " 11th " "

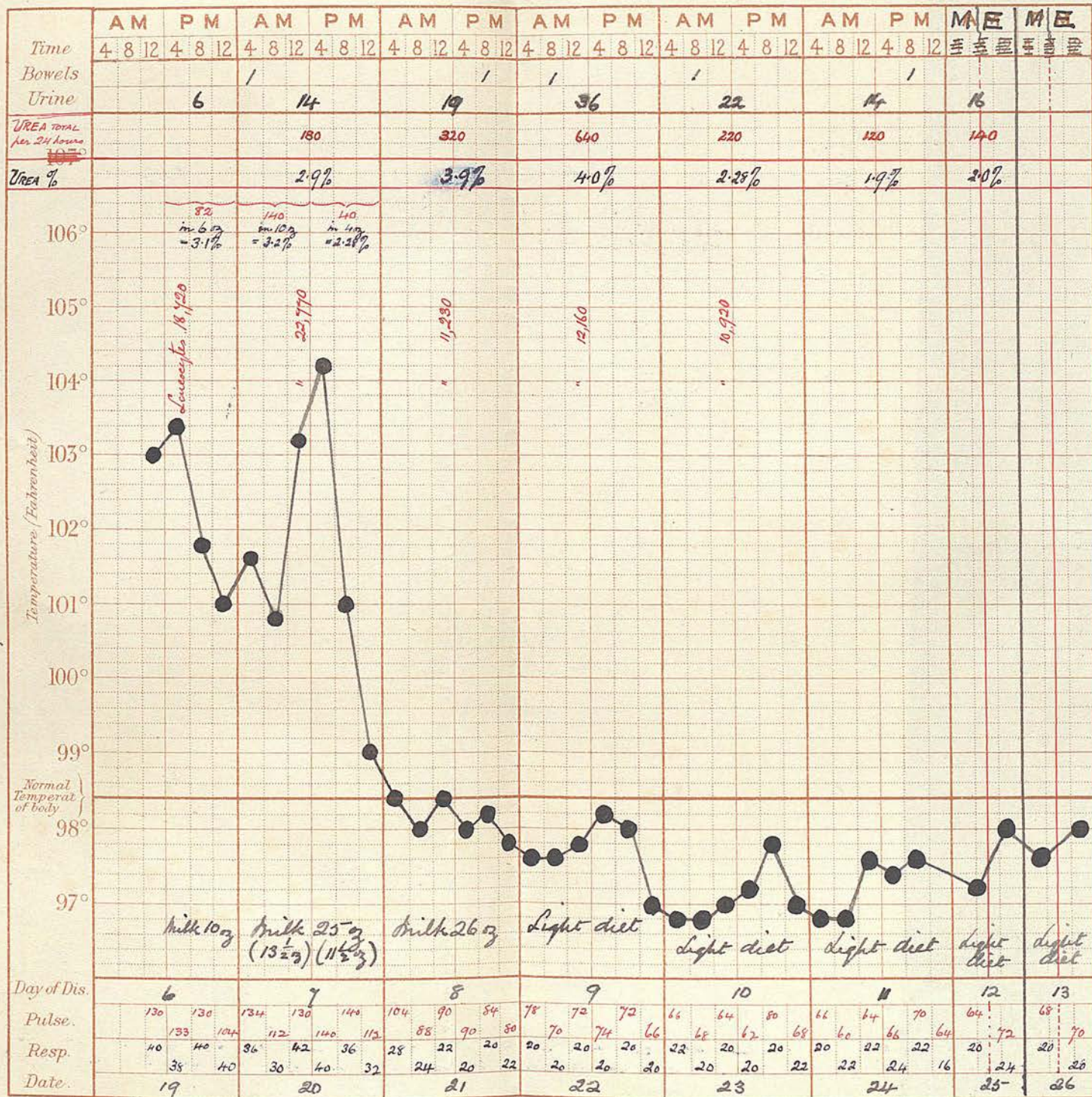
Little Sweating at
any time.

Resolution fairly
rapid.

Date of admission

19. 3. 06

Result well.



CASE IV. CASE with DIMINISHED UREA during FASTIGIUM in a MALE

CHILD of 10 years :

William McLean. 10 years. Admitted G.R.I.,
19/3/06.

Apical Pneumonia. Illness began 14/3/1906 with
a rigor at about 8 p.m.

Symptoms. Headache, Anorexia and Sickness;
great thirst; vomited twice. Cough and diffi-
culty of breathing began same night, and was soon
associated with pain in the lower part of right side
of Chest, back and front. No spit.

Mother says he never sweated much before ad-
mission, and no marked sweating was observed while
patient was in the Hospital.

On admission the signs were those of consolida-
tion of whole Right Upper Lobe and about the upper
two inches of apex of Right Lower Lobe behind.

No diarrhoea noted while in Hospital.

The temperature fell by Crisis - from 104.2°
at 4 p.m. on 7th day of illness, to 98.4° at 4 a.m.
on 8th day.

Resolution was well advanced when observations
ceased on 5th day after completion of Crisis.

For diet, pulse, temperature, respirations and
leucocyte count, see Chart.

The Consideration of this Case.

In this case there was never any diarrhoea and
no marked sweating. The Sputum was swallowed.
No abnormal quantity of Urea need be suspected to
have been lost, therefore, by the bowel or skin.
It is impossible to speak regarding the Sputum.

During /

During the Fastigium.

Unfortunately in this case observations were only possible over three periods of 12 hours previous to the completion of Crisis. They serve, however, to give us an indication of the probable diminution of the total daily Urea during, at least, a considerable part of the fastigium. Four-hourly examinations of Urea were not made in this Case.

The average twelve-hourly results of the 3 periods of the fastigium till day of completion of Crisis, were :-

Average for three half days.	Total Urine	6 oz. $\frac{2}{3}$ lbs	Average Urea Output for normal boy of this age and weight is about 170- 180 grs. per 12 hrs. (Mann and Holt). This boy was not weighed on admis- sion, but he was well grown for his age, and I should not think was much over or under aver- age weight for 10 years of age (about 5 st. Roberts, Trèves).
	Total Urea	88 grs.	
	Percentage Urea	3.0%	

According to Holt, quoted by Dr John Thomson, the average daily amount of Urine between ages of 8 and 14 years is from 32.- 48 oz. The average at 10 years may, therefore, be taken as varying between 36 oz. and 40 oz., the 12-hourly average being /

being then about 18-20 oz.

Also Holt says average daily Urea excretion from 5 years to 13 years = 16 - 21 grammes (the greatest yearly disproportion will be in the earlier years).

During the Fastigium in this Case, then, we note :-

Total Urine. The average 12-hourly amount of Urine is markedly low ($6\frac{2}{3}$ oz. as compared with 18 - 20 oz., which is about normal).

There are variations in quantity in the twelve-hourly periods not apparently bearing any ratio to average degree of temperature (over three four-hourly periods) of the same periods. (See Table on next page under 'Urea').

Total Urea. The average here is also very low (88 grs.), compared with normal 12-hourly average for this age, which is about 185-190 grs.

Though the total Urea on the 7th day is low, yet it is higher than can be accounted for by the amount of albumens absorbed in the milk on that day. For, taking the average amount of albumens in the 25 oz. of milk (given on that day) at 3%, the result is 360. grs. of albumens in 25 oz. milk.

But the average amount of albumens necessary to produce 180 grs. of Urea (according to Haig's rule, see p. 60) is approximately 540 grs. This as we see is much more than the 25 oz. milk can supply.

Variations in quantity are seen in the different 12-hourly periods. They do not appear to bear a ratio to the average degree of temperature during the same periods, e.g.,

		Average 12-hrly. Temp.	Total Urea.	Total Urine.
1st 12-hourly period		102.06°	82 grs.	6 oz.
2nd	" "	101.86°	140 grs.	10 oz.
3rd	" "	101.4°	40 grs.	4 oz.

The period from 12 p.m. on 6th day to 12 a.m. on 7th day, which shews greatest output for such a period in the fastigium (i.e., 140 grs.) is seen to include the period immediately following the completion of the fall in temperature on the previous afternoon. This appearance is in accord with those seen after just such falls in previous cases.

Again, on comparing the three 12-hourly periods, it is obvious that the amount of Urea excreted is independent of the amount of diet.

The amount of Urea varies directly as, though not in proportion with, the amount of Urine in the same period.

Urea /

Urea Percentage. The average Urea percentage for the three periods before the completion of Crisis is high (3.0%).

The percentage is much below the average during the period when Crisis is occurring (on 7th day).

Here, again, we fail to observe either a definitely direct or inverse ratio between the amount of Urine and Urea, and the Urea percentage.

The only constant feature is a heightened Urea percentage during the Fastigium. There is a reduction in percentage, though it is still above normal, covering the period of the fall of temperature at the time of the Crisis.

During Convalescence:

The Urine :

(1) There is an increase in the amount of Urine, associated with the period of post-critical rise in Urea (i.e., on day following Crisis), though the daily total is still low in amount.

(2) There is a still greater increase on the following (9th) day. It is associated with a great increase in Urea excretion, and a very sudden change on to "light diet". It is about normal in amount on this day.

(3) /

(3) There is then a gradual fall away in quantity for two days. The turning point appears, however, to be reached on the latter of these two days (the 11th), as on the 12th day after onset, a slight increase is observed. This is probably the start of a rise towards normal.

The Urea. The post-critical increase is marked here on the day of completion of the Crisis. Its relation to the termination of the Crisis is probably the same as that seen in previous cases.

The amount of diet taken on that (8th) day being an increase of only $\frac{3}{4}$ milk over the amount of the previous day's diet, does not account for it.

On the 9th day, - that following the day of the post-critical rise, an unusual appearance is seen. There is a relatively huge excretion of Urea on this day. It is probably chiefly due to the fact that the patient experienced a much more marked change of diet than the cases we have discussed previously did at a similar period. "Light diet" is noted on the Chart on that day. This includes Porridge and Milk, Rice and Milk, Fish, Chicken, and Bread in considerable quantities. The appearance is highly interesting if this be the true cause. The slight fall in temperature at end of day cannot account for much of the increase, if any at /

at all, (as it is unusual to see such an appearance with such a fall in Convalescence).

The following day (10th day), there is a very marked fall in Urea excretion, but the fall is still continued on the day after that again (11th day). The prolonged duration of the fall in Urea at this period is unusual (cf. previous Cases). The suggestion which impresses one at once, is that the dietetic disturbance (suggested before) has been so great and continuous that a readjustment of the balance (such as has been seen to occur in similar conditions in previous cases) is, ipso facto, more delayed.

At any rate, on the 11th day after onset, the amount of Urea excretion is relatively similar in proportion to the other days in this Case, and to that seen about this period, or a little earlier (i.e., immediately following termination of post-critical rise), in previous Cases.

On the 12th day the appearances are suggestive of a "turn in the tide", and a gradual return to about normal.

Unfortunately, observations were interrupted at this stage.

The /

The Urea Percentage is very high (3.9%) on the day of the post-critical rise in Urea and Urine. It is even higher than during any period noted during the Fastigium, and markedly greater than during the preceding 12 hours.

On the day following (10th day), the percentage is also markedly high (4.0%). This high percentage is associated with a great increase in Urea and Urine output on that day, and is a similar appearance to that seen in other cases on days when a change of diet occurred. The greatness of the degree in percentage is probably due to the drastic nature of the sudden change in the diet.

From this day, there is a fall to about normal on 11th, and on the 12th day the percentage is subnormal. From the 12th day, the percentage appears to be on the upward grade again. This appearance is much the same as that seen in previous Cases at a similar period,

It is impossible in this case to compare the relative rate of return to normal of the Urea, Urea percentage, process of resolution, and respirations, owing to the limited period of observation in Convalescence.

The /

The Urine here contained Albumen in gradually decreasing quantity from the time of admission till the 9th day of illness, when it was not present in the Urine in detectable amount.

Considering the Urea in this Case, we observe :-

(I) The general resemblance of this case (so far as it is possible to observe it) to Cases already discussed. These Cases are examples of the Urea excretion in Lobar Pneumonia at various ages.

(II) That the Urea excretion is low during the Fastigium from the earliest note till the completion of the Crisis.

(III) That there is not a progressive decline in Urea output from first to last in the 12-hourly periods of the Fastigium. The highest 12-hourly total amount of Urea is seen in the period (1st 12 hours of 7th day) which covers the usual period of increased output, seen at termination of a fall in temperature in other Cases.

(IV) The usual post-critical increase in Urea output.

(V) The feature of this Case. The enormous increase /

increase in Urea excretion associated with the unusually drastic dietary alteration.

(VI) The gradual fall in the total daily Urea following this, and covering a period of two days approximately: after this the indication of a rise towards normal.

The Leucocytosis, beyond shewing a fall closely associated with the Crisis, bears no definite relation to the Urea excretion. There is a slight increase on the day of greatest Urea excretion (9th day).

The Pulse changes are somewhat more closely associated with temperature changes here than is usual in other Cases. There is frequently a suggestion of a very intimate relation between the two in the Fastigium. The relation of the pulse to the Urea excretion is much that of the temperature.

The Respirations follow much the same course, shewing quite a definite Crisis (to 20 per minute), immediately following the Crisis in temperature. This Crisis in respiration rate is more marked than is usually seen in other Cases. As usual, however, /

however, the respirations do not reach normal for many days. They had not done so when observations ceased here.

It is not possible to point out in this Case the relationship, seen in other Cases, between the rate of return of the respirations and the daily Urea to normal.

CASE V. ANOTHER CASE shewing DIMINISHED UREA OUTPUT during
FASTIGIUM :

This Case is introduced here because of the great resemblance it bears to Case IV.

Matthew Ward. Vanman. 20 years. Admitted
 G. R. I. 19/3/06.

Illness began 16/3/1906 with rigor in afternoon.

Symptoms: Headache and anorexia, but no sickness or vomiting that patient can recollect.

Cough and tenacious sputum. Soon began to suffer from shortness of breath.

Pain in Left side of Chest about region of nipple.

On admission, physical signs indicated consolidation of entire Left Lower Lobe.

No diarrhoea during period when under observation.

Little Sputum at any time.

No marked sweating till period of Crisis. Immediately before Crisis set in, patient began to perspire fairly freely. This epicritical sweat lasted about 20 hours.

Crisis began between 4 a.m. and 8 a.m. on 6th day, and crossed the normal line between 4 a.m. and 8 a.m. on 7th day. The fall shewed one "break" of about 4 hours' duration.

Resolution proceeded moderately rapidly. On 11th day of illness, there was still some heightened pitch in lower part of L.L.L. behind. No crepitations.

There was a deposit of albumen in the Urine (C. Esbach's reagent) on 4th and 5th days. No albumen detectable after that.

4 HOUR CHART.

DISEASE.

Pneumonia

L.L. Lobe (totally involsed)

Name { Mattheus
Ward

Age 20 yrs

Diet see chart

Case Book N^o

Notes of Case

Inset 16. 3. 1906

Rigor
Headache
Anorexia. No sickness or vomiting

Cough + tenacious spit.

Shortness of breath

Pain in L. Chest (about nipple)

Albumen in Urine

= a deposit on 4th & 5th days

No alb. present later.

h. diarrhoea

Little Sputum.

Little sweating tree cross.

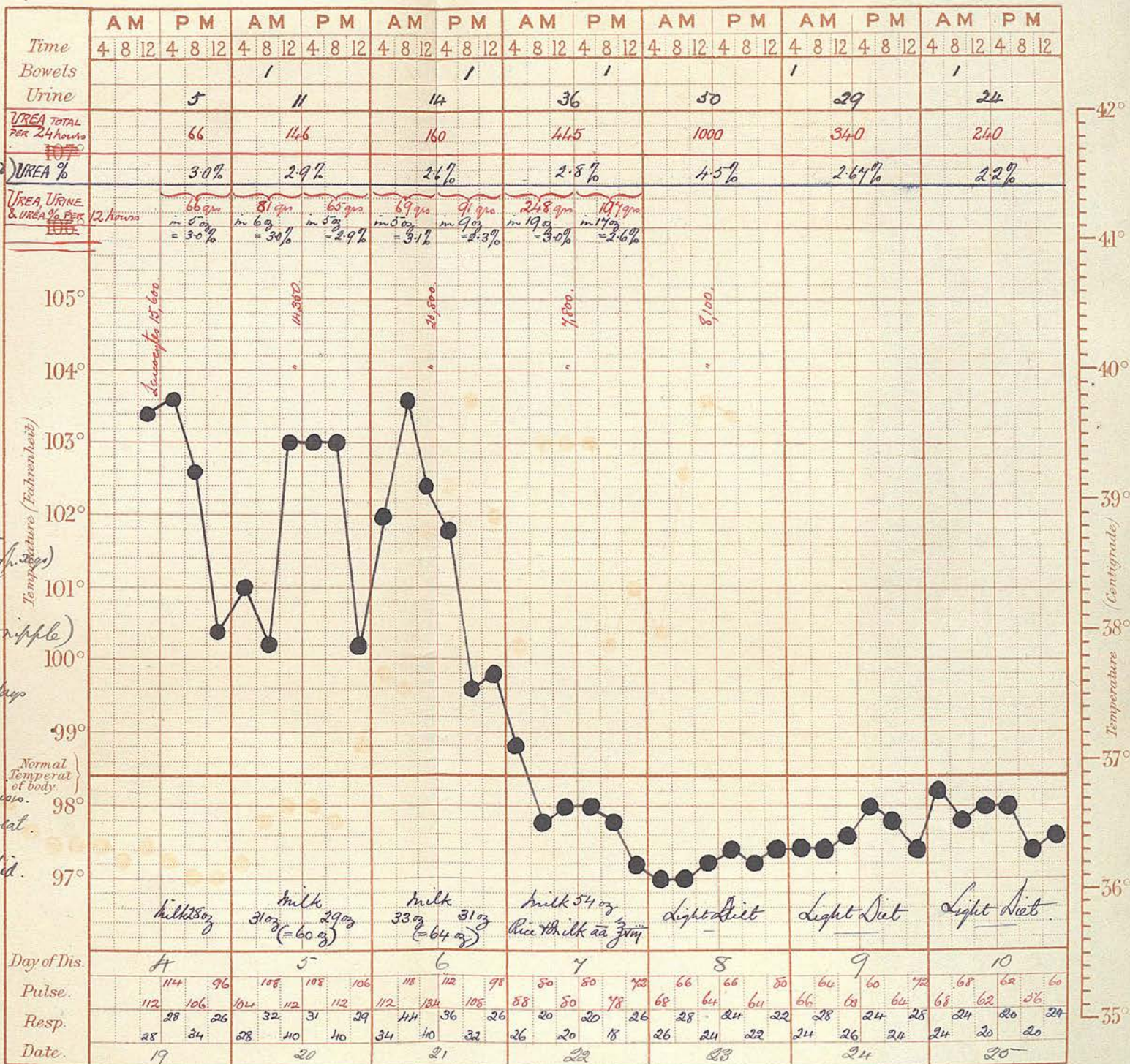
Fairly free critical sweat.

Resolution moderately rapid.

Date of admission

19.3.1906

Result.....well



The Consideration of this Case. This, the 5th Case of the series, occurs in an adult; bears a close general resemblance to the four previous Cases discussed, and especially to Case IV.

There is no reason here to suspect that there was any unusual escape of Urea at any time by any other channel than the Urinary one.

The Urine and Urea are noted daily and half-daily in this Case, as in Case IV. We thus get five 12-hourly periods in the Fastigium before the completion of the Crisis. We shall discuss the 12-hourly instead of daily averages in this Case.

Considerations during Fastigium.

The total 12-hourly average for 5 periods till completion of Crisis is :-

		In this Case.	Normal healthy average amounts per 12 hours for man of this age.
Over 5 $\frac{1}{2}$ -daily periods.	Total Urine	6 oz.	25 oz.
	Total Urea	74.4.grs.	250-275 grs.
	Percentage Urea.	2.86 %	2.0 - 2.2%.

Total Urine. The average output (6 oz.) is markedly low during fastigium.

The /

The usual variations in amount of Urine are seen in this Case. The cause is not apparent, but there is a direct, though not proportional, relationship between the amount of Urea and Urine in the same periods. No definite relationship is evident with average degree of temperature, nor with amount of diet in the same periods.

The amount of Urine is highest (9oz.) in the 5th (and last) 12-hourly period. This is associated with the increased Urea output at this time, also probably the result of the "break" in the Crisis, which occurs during that period (similar to appearance seen in J. Biondi, Case II).

Total Urea. The total average Urea for the five 12-hourly periods of the Fastigium is markedly low (74.4 grs). The healthy normal in an adult is about 250 grs. - 275 grs. per 12 hours.

Relation to Temperature. In the fastigium in this Case, there is some appearance of an inverse relationship between the total Urea and average temperature in the 12-hourly periods. It will be seen from a perusal of the columns on next page, however, that the relation is not definitely proportional :-

last /

		Periods.	Aver. Temp.	Total Urea.
last $\frac{1}{2}$	4th day	1st 12-hrly.period	102.2°	66 grs.
5th day		2nd " "	101.4°	81 grs.
		3rd " "	102°	65 grs.
6th day		4th " "	102.6°	69 grs.
		5th " "	100.4°	91 grs.

The appearance of an apparent inverse ratio is no doubt due to the fact that after the falls in temperature seen on the 2nd half of the 4th and 2nd half of the 6th days, the temperature remains down (for 12 hours in first instance and continuously in the second instance). Thus we have a low temperature average in the 1st half of the 5th day and second half of 6th occurring synchronously with the usual increased Urea output, which, from a consideration of previous Cases, we should have been led to expect in any case after such falls of temperature.

A comparison of the relative amounts of Urea with the average temperature in the 1st, 3rd and 4th periods shews that the inverse ratio does not hold good for these periods.

The three 12-hour periods which shew the highest Urea outputs in the Fastigium are those following the /

the completion of the marked falls of temperature on the 4th, 5th, and 6th days. The greater part of the increase in Urea after the completion of the temperature falls on the 4th and 5th days does not seem to have appeared till the four-hourly periods following the completion of the fall of temperature in each case. Similar appearances were observed in previous cases and an explanation offered in Case I.

The marked increase in Urea output seen in the latter half of the 6th day is probably associated with the "break" which is seen in the Crisis during that period. A similar appearance to this was seen in Case II (Biondi).

It is not possible to say exactly how long these rises in Urea output lasted owing to lack of four-hourly notes, but they appear to have been completed during the 12-hour period in which they are first noted.

Relation to Diet. No obvious relationship is evident to the amount of diet taken during the Fastigium.

The /

The relation to quantity of Urine has been observed under "Total Urine".

There is not present in this Case (as found by Osler and Vierordt in their Cases) any suggestion of gradual and steady decrease in Urea output in the direction of the Crisis.

Urea Percentage. The average Urea percentage for the five 12-hourly periods in the Fastigium here is high (2.86%). The percentage is very constant (3.1% to 2.9%) in all the periods except the last. In this period there is a marked reduction in percentage (2.3%), though it is still above normal. A similar fall is seen under similar circumstances in other Cases (e.g., Cases I and II).

The percentage does not appear (1) to depend definitely upon the volume of the Urine, nor (2) to vary directly or inversely as the volume of Urine or Urea; though the reduction of percentage at the period of the "break" in the Crisis has been noted.

The only relation between Urea percentage and temperature apparent here (as elsewhere) is a high percentage during the fastigium. No apparent relation to general degree of temperature in each 12-hourly period is observed.

During /

During Convalescence.

The Urine. There is here to be noted :-

(1) A sudden increase in the total quantity of Urine on day of Crisis (to 36 oz.). This increase is seen to be greatest (to 19 oz.) in the first 12 hours of the 7th day - the period in which the Crisis is completed. The post-critical rise appears, however, to be continued into the following 12-hourly period. This appearance is what we should expect from our observations of the duration of the post-critical rise in previous Cases, (or the addition to the diet in that period may have something to do with it).

(2) There is a still further increase on the following (8th) day. This is associated with a much greater proportional increase in Urea excretion. Both are associated with the sudden unusually pronounced change in diet on this day (note the resemblance to Case IV).

On the 9th day there is a considerable fall in Urine excretion, but a still lower level is reached on the 10th day.

The explanation is the same as in Case IV.

Observations ceased at this point, and a further consideration of the conditions in Convalescence is, therefore, impossible.

The /

The Urea. There is here to be noted :-

(1) A marked post-critical rise (from 91 - 248 grs.) evident in the 12-hourly period in which the temperature reaches normal. From the fact that the Urea is high in the following 12-hourly period also, it may be deduced that the increase began at, or immediately after, the four-hourly period when Crisis was complete (that is, assuming post-critical rise in output of Urea to have been of similar duration to the rises seen in all previous Cases.

(2) A high Urea output in the latter half of 7th day. The amount (197 grs.) represents a fall, however, as compared with the previous 12 hours (the earlier period of the post-critical rise). The high output in this period may be in small part due to the slight alteration in diet, made about 12.30 p.m. on 7th day, but probably much more to the fact that the post-critical rise is most likely not quite complete at the beginning of this period.

The following (8th) day, an enormous output of Urea is observed (1,000 grs.). The only previous Case with a similar appearance is Case IV, and it is interesting to note that here, as in that Case, a dietary change was made (on corresponding days) of an unusually drastic nature. Here the change is from 52 oz. Milk and 8 oz. Rice right on to Light Diet; /

Diet; this latter implied :-

Porridge $\overline{3}$ vi.

Chicken and gravy $\overline{3}$ iv.

Bread $\overline{3}$ iv.s

Tea $\overline{3}$ iv. about.

Rice $\overline{3}$ viii.

Milk $\overline{3}$ viii, about.

A great and associated increase in Urine is apparent here as in Case IV, but in both the increase is not proportional to the increase in Urea, and, therefore, the percentage is unusually high.

Here (as in Case IV), the return to about the original level does not occur so rapidly as in Cases where the change is not so drastic. The day following the change of diet, the daily excretion is 340 grs., but there is a further decrease by 100 grs. on the following day. At a similar period in Case IV to the 10th day in this case, the Urea output was at its lowest, the following day giving indication of a "turn in the tide" of total daily Urea excretion. It is only possible to suggest that a similar occurrence might have been witnessed in this Case had observations continued.

The /

The Urea Percentage. The percentage during the period of post-critical rise is high (3.0%) here, as in other Cases. It is not, however, greater than the average height in the fastigium, though representing a considerable increase over the percentage in the previous 12 hours.

Though still well above normal in 2nd half of 7th day, there is a relative decrease of 0.4% from the percentage noted in the first half of the day. The following (8th) day - the day of great dietary alteration - there is a markedly high Urea percentage (4.5%). A similar appearance is seen in almost every other instance in previous Cases associated with a change in diet in Convalescence.

The next day again (9th), the percentage (2.67%) shews a return to the level it attained on 2nd half of 7th day. The fall away in percentage is, therefore, remarkable.

On the 10th day, the reduction in percentage is continued, but it is much less marked.

Thus, there appears a more or less gradual decline towards normal in percentage from the time of post-critical rise, broken on the 8th day by a great increase in percentage associated with dietary alterations. So far as observations go, therefore, there is no evidence of a low percentage during Convalescence, whatever appearances may have been at a later period.

The briefness of the period of observation here does not allow of comparison being made between rate of return to normal of the Urea, Urine, Urea Percentage, and Respirations, and rapidity of process of resolution.

Resolution appeared to be rather slower in this case than in some others.

The Urine in this Case contained albumen in considerable amount - a deposit with Esbach's reagent - on the 4th and 5th days. No albumen was detected later.

Considering Urea in this Case, then, we observe:-

(I) A low Urea excretion during the fastigium from the earliest note till the Crisis. It is not possible to say whether the amount was greater in the earlier periods of fastigium, but there is no evidence of a progressive decrease in the direction of the Crisis.

(II) A temporary increase in Urea excretion in the periods following certain falls of temperature in the fastigium.

(III) /

(III) An increase in Urea output at the period of the "break" in the Crisis.

(IV) A marked post-critical increase probably lasting 8-12 hours.

(V) A huge increase in Urea excretion synchronous with drastic dietary alterations.

(VI) Equilibrium not apparently regained so rapidly as usual after a change of diet. The fall of Urea output to low level progresses for two days.

The Leucocytes shew a crisis synchronous with the temperature crisis. No other apparent relation to Urea output is observed.

The Pulse remains high while temperature is so, and shews a critical decline closely associated with the crisis in temperature. This appearance is as in previous Cases. Though in general the pulse follows the rises and falls of temperature during the fastigium, yet the four-hourly variations are not always in proportion to temperature variations, and, indeed, often vary inversely. Thus, there is apparently no absolutely constant intimacy or proportion in relationship between the two so far as can be judged in the four-hourly periods.

The /

The relationship between Pulse and Urea is similar to that between temperature and Urea, but is even less definite.

The relationship between respirations and temperature in the fastigium is somewhat similar to that pointed out between the pulse and temperature. As regards Urea, the position is similar during fastigium to that stated in considering the pulse. After Crisis, return of respirations to normal is slower than pulse, and had not occurred when observations ceased.

to show 12 hour urea, Total amount of $\frac{1}{2}$

DISEASE.

Name { James
Cavanaugh
Age 34 yrs.
Diet (see chart)

Case Book N^o
Wright made ⁱⁿ 11st 6 $\frac{3}{4}$ lbs.
Notes of Case

Pneumonia R Lobe (totally)
says injury to back 30-300
Onset 1.4.04
Rigor
Headache
Cough & sput
Pain in rt side & front of

Temperate in Alcohol
No alcohol given in
Wards. _____
No Marked Sweating

Wetness Albumenous
till 4 am - 11th day
Resolution ^{rapid} ~~admission~~ fairly ~~refined~~
size a ~~small~~ patch at
very base dull & R.M. tubular
on 14th day
Date of admission

Result well.

[illegible]

CASE VI.

CASE with INCREASED UREA during FASTIGIUM.

James Cavanagh. 34 years. Admitted G.R.I.
5/4/1907.

Illness began 1/4/1907. Patient says had injury to back on 30/3/07. Rigor about 2 p.m. 1/4/1907.

Symptoms. Headache, and Anorexia. No vomiting. Same evening had cough and tenacious spit, which the following day was 'rusty'.

Same day experienced a catching pain in right side and front of chest low down. Worse on coughing.

Shortness of breath became troublesome about same time. No marked sweating at any time. More in first two days of illness. Slightly increased sweating at time of true crisis.

On admission, signs were those of consolidation of whole Right Lower Lobe. No indication of extension of consolidation later.

No diarrhoea. Sputum not very abundant. Pseudo crisis on 7th day.

True crisis occurred on 8th and 9th days.

Resolution was well advanced on fourteenth day after onset of illness, though there was still a patch of pleuritic dulness at base of Right Pleura behind. Some medium crepitations at base of R.L.L. on this day.

The Consideration of this Case.

There is no reason to believe that any great quantity of Urea left the body by channels other than the Urine (c.f. sweat, faeces, and sputum).

(a) During the Fastigium. Though the eighth day belongs to the fastigium, yet in order that we may /

may be in a position to consider a daily average more correctly representing the true condition of affairs during the fastigium in this case, two sets of averages are taken, one over the sixth and seventh days only, the other over the sixth, seventh and eighth days. This is done because there is a very marked pseudo-crisis on the eighth day, which is associated with an increased Urea and Urine output at its termination. This post-pseudo-critical increase considerably affects the amount of Urine and Urea on that day. The pseudo crisis will be examined separately also. The average results for two complete days before crisis are :

Total Urine	37.5 oz.
Total Urea	708 grs.
Urea %	4.3 %

or (including eighth day) for three complete days :-

Total Urine	41.6 oz
Total Urea	763 $\frac{1}{2}$ grs
Urea %	4.16%

Taking into account along with these averages the period of eight hours during which the Urine was collected and Urea estimated on the fifth day (see chart), the above results would be little altered /

altered; for 222 grs of Urea in 12 oz of Urine were excreted in 8 hours = an average of 666 grs in 36 oz Urine for 24 hours. These amounts are much similar to those of the day (6th day) following. They are much above the daily average in health.

Total Urine. (Considering the 2 day periods) the daily average amount is below normal (37.5 ozs). The daily average Urine for the 3 days (6th, 7th, and 8th) is also below normal in health (41.6 ozs).

There are variations in the daily, 12 and 4 hourly quantity of Urine in the fastigium which are not explainable either by temperature or diet in the same periods.

There is a marked increase in Urine at the time of the post-pseudo-critical rise in Urea. 30 ozs are passed in 12 hours, which amount is above the average in health. A similar appearance to this is seen in Cases I. and IV. at the periods of pseudo-crisis and 'break' in the crisis respectively.

Total Urea. The total daily average Urea in the fastigium in this case is high - 708 grs for 2 days (or including 8th day 763 $\frac{1}{2}$ grs for 3 days).

In Parkes¹ series of daily Urea averages in healthy /

¹ Parkes "The Composition of the Urine 1860 p. 290".

healthy adults, the highest recorded quotation given is Hammond's (Boston, U.S.A.) - namely 670 grs. This is admittedly an unusually high average, and no other observer appears to have got such a high result.

But the daily average here exceeds Hammond's average by 38 grains in the 2 day average table, and 93 grs in the 3 day table (that including the eighth day).

The increase above normal is all the more apparent when we consider that :

(1) The quantity of nitrogenous material ingested is not, according to Haig's mode¹ of calculation (which is admittedly a pretty accurate one) sufficient to maintain nitrogenous equilibrium. The average diet here for the 2 days (6th and 7th) is 77.5 ozs milk. This is considerably below the requirements of a man of this weight and age.

(2) The power of absorption of nitrogenous food taken is reduced in fever. This latter fact is well known.

Bearing on this question is the following observation :- From a comparison of this and previous cases it appears that the excess over, or diminution from, the normal of the average daily Urea excretion /

¹ Haig "Diet and food in relation to strength and power of endurance" 1892. p. 6".

excretion in the fastigial period of Lobar Pneumonia, is not dependent upon the amount of nitrogenous diet taken during that time.

From a study of the chart in this case, on the 6th, 7th and 8th days of illness it is apparent that the total daily Urea excretion in the fastigium bears no relation to the amount of nitrogenous diet :-

Day	Amount of milk taken	Total Urea.
6th	88 oz	667 grs
7th	67 oz	749 grs
8th	74 oz	874 grs.

So far as the case allows, the same daily variations in the total Urea output in the fastigium are apparent as in Cases I. to V. The twelve-hourly periods here, however, show the variations more definitely.

Relation to Temperature. These variations, it is evident, bear no constant definite relationship to the average degree of temperature, either daily, twelve-hourly, or four-hourly. e.g.

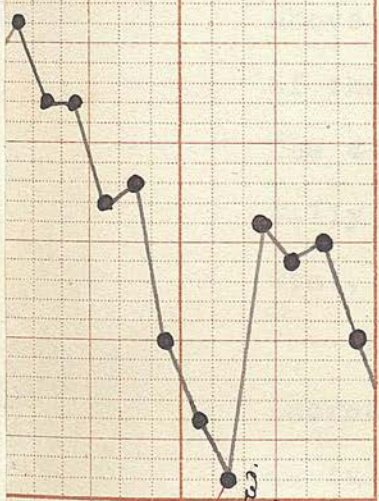
Daily—average temp.		Total Urea.
6th	101.06°	667 grs
7th	101.83°	749 grs
8th	100.13°	874 grs.

J. Cavanagh. To explain rise in urea output after pseudo-crisis,

A M			P M			A M			P M		
4	8	12	4	8	12	4	8	12	4	8	12
7	4	8	8	8	7	4	9	11	10	8	8
125	70	143	149	143	119	59	161	182	175	140	157

518 gms

Milk 10 oz
 " 8 oz
 " 9 oz
 " 10 oz
 " 14 oz
 " 16 oz
 " 8 oz
 " 10 oz
 " 18 oz
 " 20 oz
 " 8 oz
 " 10 oz



NB. This Temp taken immediately before urine was collected for the 4 hourly period

7
7

8
8

12-hourly — Average Temp. Total Urea.

6th day	1st 12 hrs	100.46°	317 grs
	2nd " "	101.6 °	350 grs
7th day	1st " "	102.6°	338 grs
	2nd " "	101°	411 grs
8th day	1st " "	99.6°	402 grs
	2nd " "	100.6°	472 grs.

A table for comparison of 4-hourly Urea and temperature is unnecessary as the truth of the above statement is at once obvious on examination of the 4-hourly notes on the temperature chart. The 4-hourly appearances, however, will be more fully discussed in relation to temperature, diet, etc., later on in a separate chapter.

In this Case again we note that there is an increase in Urea output after the completion of certain falls in temperature, i.e., 6th and 8th days. This is the only apparent relation which I am able to observe between temperature and amount of Urea excretion.

The Pseudo Crisis. On the 8th day a pseudo-crisis occurred in this case. During the 12 hours beginning with the termination of this fall in temperature there is an increase in Urea output. In all 518 grs Urea were excreted in that time. There /

There is also an increase in amount of Urine secreted. A somewhat similar appearance was seen at the time of the 'break' in the crisis in Case II, (and also Case I. at time of pseudo-crisis) and the discussion of the question there and the conclusions reached apply to this case also. The Urea percentage is temporarily reduced in both cases. It is obvious from a study of the 4-hourly chart (a small 2 day chart is appended) that the amount of milk taken is not in any definite ratio to the amount of Urea excreted in each 4-hourly period. Also the increase in Urea is greater than can be accounted for wholly by extra amount of milk taken.

Highest Urea in fastigium. Excluding the day of completion of the pseudo-crisis, the highest daily amount of Urea noted in the fastigium is on the 7th day of illness. The increase is almost totally confined to the 2nd 12 hours of that day, when 411 grs Urea (and 23 oz Urine) were passed. I am unable to offer a definite explanation for this increase. Certainly the extra 13 oz milk taken in latter half of day will not wholly account for the extra 73 grs Urea. (Besides, we have already seen the lack of relation between amount of milk taken and of Urea excreted, e.g. 6th and 7th days).

The /

The only plausible suggestion is that the 4-hourly increases seen at this time, are consequent upon, and follow the two brief "breaks" in the pseudo-critical fall of temperature at that time.

In this case there is a gradual rise in daily Urea output from the first daily note till day of crisis. The causes of this appearance are the increases in Urea output on the latter half of the 7th and first half of the 8th days. The reasons for these increases in Urea we have endeavoured to explain.

Relation to Urine. In this case as elsewhere, it is evident that the total daily Urine varies directly, though not proportionately, with the amount of Urea excreted. The observation holds good for all the 12-hourly periods also, except that which comprises the latter half of the 6th day of illness.

The 4-hourly relationship is not quite so definite. This is no doubt partly due to the unit of measurement in case of the Urine, (the ounce) being so large as to make a reckoning rather uncertain when dealing with small quantities - such as those noted in the 4-hourly periods. This explanation, however, may not wholly account for the irregularities in relationship evident in some of the 4-hourly periods. The question will be discussed in a separate Chapter, at a later period.

We are, of course, unable in this case to discuss /

discuss the conditions of Urea excretion at the onset, and in the earlier part of the fastigium.

The Urea percentage. The average daily Urea percentage here is very high in the fastigium - i.e., for the 2 (6th and 7th) days = 4.3%, or for 3 days including 8th day = 4.16%.

That the percentage is fairly constant in the different periods is evident from a consideration of the 12-hourly periods: it varies between 4% and 5% except at the time of the pseudo-crisis when it is 2.3% for the 12 hours immediately following the completion of the pseudo-crisis. This fact has already been commented upon.

In the daily and 12-hourly periods we observe here as in other cases :-

(1) That the Urea percentage does not appear to depend on the volume of Urine in any way, either in 24-hourly or shorter periods.

(2) The percentage does not appear to vary inversely as the amount of Urine or Urea, either daily or in the shorter periods.

(3) That there is only a general relationship between Urea percentage and temperature, i.e. a high percentage in fastigium. No apparent relation between percentage and degree of temperature.

(b) During Convalescence.

Immediately /

Immediately the Crisis is complete, a post-critical increase in Urine, Urea and Urea % is evident. The increase lasts for more than 8 hours. The increased intake of milk is not sufficient to account for the increase in Urea output (i.e. the extra 8 oz milk will not supply sufficient albumen to produce the extra 225 grs Urea).

The Urine.

There is a fall away in amount of Urine output for the 12-hourly period immediately following the period of post-critical increase. This fall is continued on the first half of the following day.

On 2nd half of this (10th) day, there is an increase in Urine from 22 ozs to 27 ozs. The increase is associated with an increase in the Urea excretion and a change in diet.

The 12-hourly quantities remain practically the same for the 4 periods following this (11th and 12th days).

On 13th day, owing to a mistake, the Urine was only collected for 16 hours. An average for the 24 hours works out at 45 ozs. A similar amount is registered on the 14th day. So far, therefore, there is evidence of a slow decline in total daily Urine.

The /

The next observation was taken over a period of 24 hours on 16th and 17th days. The total Urine for the 24 hours had then risen again to 65 ozs.

In this case then, it is observed that there is a fall in Urine quantity for a time after post-critical rise. This is succeeded in 24 hours by a renewed increase. From that time onward, there is a decline in amount towards the normal in health, about which level the Urine probably oscillates from that time.

The Urea.

The post-critical rise in Urea is very marked. (707 grs in 12 hours).

After the post-critical rise is complete, there is a fall in Urea output for 24 hours. The daily amount is still far above normal, however.

As the Urea tends in all cases (vide ante et post) to return more or less gradually to normal from this period, it seems natural that this case should show a gradual decline, instead of a gradual rise, as seen in cases where the Urea has been sub-normal after the completion of the post-critical increase. And this is exactly what is observed here.

On the 2nd half of the 10th day there is a sudden increase (marked in 4-hourly periods) associated with a change in diet. For four 12-hourly periods /

periods following this (i.e. the 48 hours of the 11th and 12th days), there is a steady fall in Urea output. The reduction in these four instances is, however, very slight (12 - 22 grs). The smallness of these reductions is probably due to the fact that considerable additions are being made to the diet in each period. These dietary additions, though not causing apparent upward jumps in total Urea excretion as seen in those cases where the Urea is subnormal, and is climbing gradually upwards (e.g. Case I.), yet in reality have similar results, by making small what would probably otherwise be very evident falls in the total amount of Urea output. On the 13th day, when additions to the diet cease, there is an immediate and immense fall in Urea excretion to a daily average of $649\frac{1}{2}$ grs (433 grs in 16 hours).

This is in accordance with what we should expect to find, as the line to normal here is a line of descent, and not a line of ascent as in cases where Urea output is low after the post-critical rise, and added to the ordinary daily fall we have the fall which we have already seen to occur in previous cases as the effect of a change in diet passes off.

A similar large fall in total Urea output is seen again on the following - (14th) - day. This brings the total daily Urea to about normal.

A 24 hours observation begun 32 hours later shows the total Urea output lower still, but as resolution was - judging by paucity of physical signs - apparently very nearly complete, this is possibly only part of an oscillation about the normal.

The Urea percentage :

With the onset of the post-critical rise in Urea output there is evident, as is usual, a much increased Urea percentage (5.3%). This high percentage lasts for the duration of the post-critical rise.

From that period onward, there is a steady decline in the percentage of Urea. The decline is very slight whilst changes in diet are occurring, but it becomes marked when the dietary changes cease. Indeed, on the 14th day there is a fall of one whole degree in percentage.

On the last 24 hour period noted, the percentage was 1.5%, which is subnormal in health. This probably represents simply an oscillation about the normal level.

To sum up then, in this Case there is seen :-

(1) Subnormal Urine during the fastigium, but the reduction /

reduction is much less marked than in cases with low fastigial Urea excretion.

- (2) A high daily average Urea excretion and a very high Urea percentage during the fastigium.
- (3) A pseudo-crisis on the last day of the pyrexia associated with a "post-pseudo-critical rise" in Urea and Urine and a lowered Urea % - the whole of about 12 hours duration.
- (4) A marked post-critical rise in Urea and also in Urine and Urea percentage - lasting about 12 hours.
- (5) A total daily Urea above normal in the first 5 days of convalescence, and shewing a more or less gradual decline to about normal. The Urea and Urine are never markedly subnormal so long as observations are continued.
- (6) A gradual decline in Urea percentage during convalescence till it finally oscillates about normal.
- (7) The effect of dietary changes.

A comparison instituted with Case I, shews :-

Case I. /

CASE I.

CASE VI.

- | | |
|--|---|
| <p>(a) Low average daily Urea during fastigium. Very low average daily Urine secretion. High average Urea percentage.</p> | <p>(a) High average daily Urea in fastigium. Subnormal Urine, but much greater average amount than in Case I. Higher average Urea % than in Case I.</p> |
| <p>(b) Post-critical rise in Urea, Urine and Urea %. A fall in all 3 on its completion.</p> | <p>(b) Post critical rise in Urea, Urine and Urea %. A fall in all 3 at its completion. Increase in Urea output greater here, but in much same proportion as in Case I.</p> |
| <p>(c) More or less gradual rise of average Urea and Urine, but decline of Urea % in convalescence to about normal. Daily average Urea oscillating near normal from 7th day after crisis. Urine and Urea percentage oscillating during return to normal, but hardly at normal when observations cease.</p> | <p>(c) More or less gradual decline of average Urea and Urine and of Urea % to about normal. Seems to reach this point about 6th day after completion of crisis, ∴ rather more rapid return to about normal than in Case I.</p> |
| <p>(d) Effect of Dietary Changes.</p> | <p>(d) Essentially similar, though appearances differ.</p> |

The Leucocytes were not done daily in this Case.

The pulse here shows a general relation to the temperature. This relationship is not proportional, however, and is not always in evidence in the four-hourly periods. There is an immediate fall in average pulse rate with the pseudo-crisis and true crisis in temperature.

There /

There is no apparent relation between the pulse rate and amount of Urea output in the 4-hourly periods.

The Respiration rate shows a general relation to the temperature all along till the time of the crisis. The rate shows a fall by lysis beginning with the pseudo-crisis and not being quite complete at the time of the last note. The return towards normal of the respiration rate in convalescence appears to be more or less contemporary with the return of Urea, Urea % and the process of resolution.

Pneumonia R.L. Lobe
(totally involved)

Name { Edward
Hanklin
Age 24 years
Diet see chart

Case Book N.º

Anslet 23.3.1907

Rigor
Headache
Cough & Sticky Spit
Pain in rt side of chest
(low in axilla)
No vomiting

No albumen in urine
during period of
observations.

Resolution fairly rapid

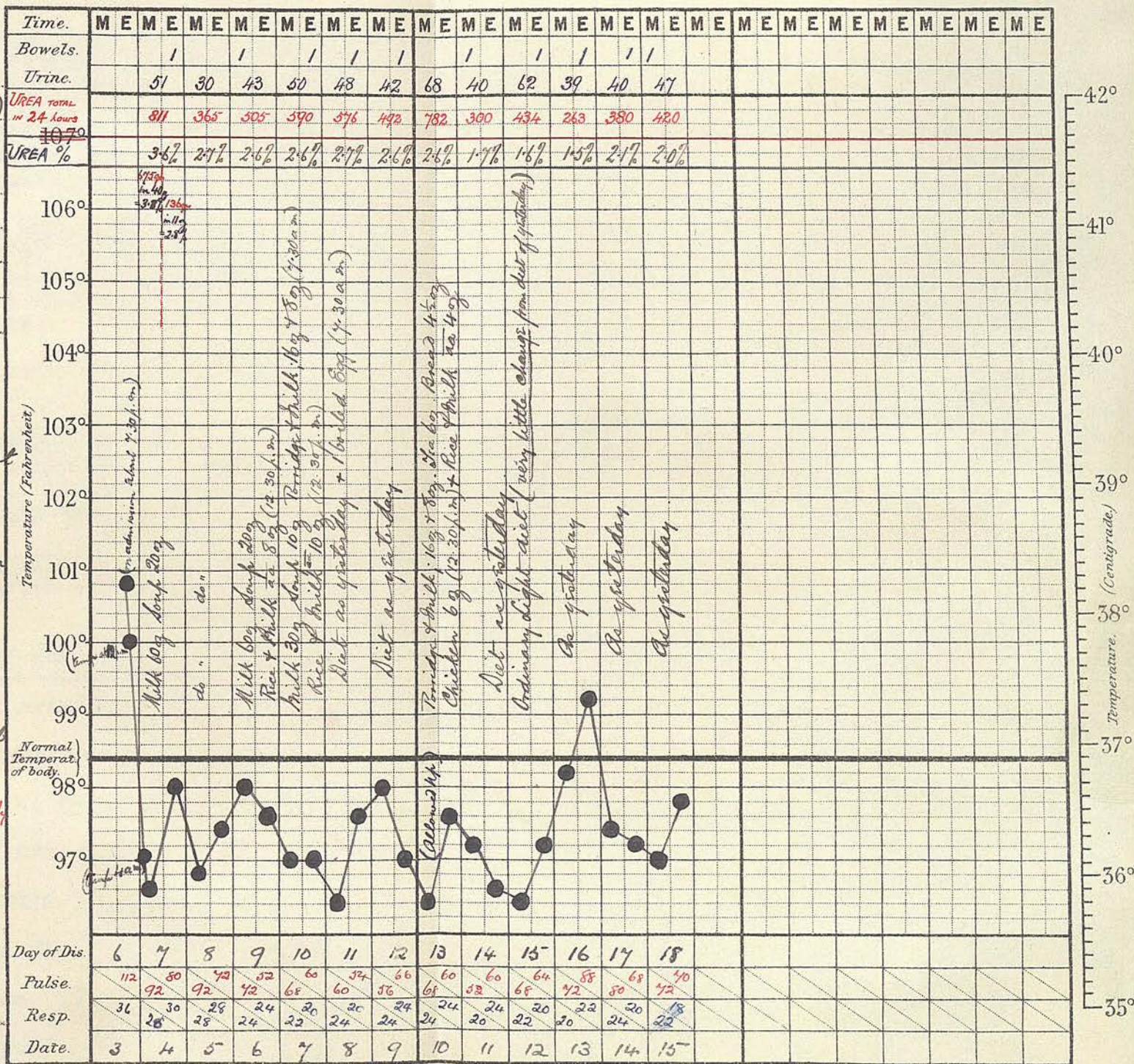
Marked epurificational
Sweating.

Leucocytes not done daily

Date of admission.

3. H. 1904

Result well.



CASE VII.

A CASE shewing APPEARANCES during CONVALESCENCE.

Edward Hanlin. 24 years. Admitted G.R.I. 3/4/1907. Illness began 23/3/1907 with a rigor.

Symptoms. Headache and Anorexia. No vomiting or sickness patient says. Cough and tenacious sputum same day.

Soon began to experience pain in right side of chest about upper limit of the deep liver dullness in mid-axillary line.

On admission. Physical signs indicated consolidation of entire Right Lower Lobe. No diarrhoea at any time patient says. Patient says no marked sweating during fastigium. Epicritical sweating considerable.

Crisis was evidently occurring at time of admission.

Resolution was fairly rapid. There was only a very occasional medium crepitation heard at base of R.L.L. behind on 18th day after onset, when observations ceased.

No albumen was detected in the Urine at any time during the period of observation.

The consideration of this Case :

As crisis was occurring when this case came under observation, no observation of fastigial period was possible. The period of convalescence in this case resembles in appearance the convalescent period in Case VI, rather than that seen in the type which has low daily Urea output in the fastigium, of which Case I. is a sample. At time of the post critical rise, the Urea output is much above /

above normal, and Urea output remains high for a number of days during earlier part of convalescence and shows an oscillating fall in daily quantity as convalescence proceeds. But the Urea excretion is subnormal for a few days towards the end. The last 2 days witness an increase again towards normal.

During Convalescence. The collection of the Urine and estimation of Urea was begun 12 p.m. on 6th day.

The Urine. The temperature here reached normal sometime between 12 p.m. on 6th day and 4 a.m. on 7th. The post-critical rise in Urine and Urea is obvious on 7th day. There is no note of the amount of Urine in the fastigium, but the amount for the 7th day - the day of completion of crisis - is great (51 ozs). It is equal to the normal amount of daily Urine secretion in health. It is associated with a Urea excretion of 811 grs for the 24 hours, which amount is much above the normal average output for a like period in health. The Urine secreted in the 8 - 12 hours immediately following the crisis is 40 ozs. (See Chart).

There is a marked fall away in amount of Urine for the next 12 hours - the amount is 11 ozs only.

The /

The amount for the following -(8th) - day is also low, (30 ozs), but gives a higher average per 12 hours than does the last 12 hours of 7th day, - the period just mentioned.

On 9th day there is an increase of 11oz in the daily total Urine. This increase is synchronous with an increased Urea excretion; and an addition to the diet.

On 10th day again, a further increase of 7 ozs of Urine occurs. It is also associated with an increase in Urea excretion, and a further addition to diet.

From this day onwards, there is a more or less gradual decrease till the 16th day, when the total amount of Urine is 39 ozs. This decline is broken by two upward oscillations, the amount registered on 13th day being 68 ozs, and on 15th day, 62 ozs. These 2 increases are both synchronous with dietary alterations. Whether the exercise first allowed on the 13th day is a factor in the causation of the increase in Urine output on that day, it is impossible to say, but it probably had some effect. The increase is difficult to account for otherwise. The 17th day witnesses a cessation of the tendency to daily decrease, there being a slight increase in amount on that day.

On /

On the 18th day the amount is practically normal.

In this case, then, there is a post-critical increase in Urine output, lasting about 12 hours. It is followed by a temporary decrease, lasting 24 to 36 hours. Then, there is an increase for 2 days, and from that time an oscillating decrease for 6 days to a subnormal amount. Then, on the last two days there is an increase again to about normal.

The Urine is observed to vary directly, though not proportionately, with the amount of Urea excreted.

The Urea. There is a very marked post-critical increase in Urea output - 811 grs for the whole day. This amount is much above normal for a like period. 675 grs of this total were excreted in the 12 hours immediately following completion of crisis. The last 12 hours of this day shows a marked fall in Urea output, only 136 grs being excreted in that time.

The Urea output on the next 24 hours (8th day) shows an increase, though it is still subnormal in amount.

On the 9th day there is a marked increase in Urea output. The total daily amount is about normal. /

normal. The increase is synchronous with an addition to the diet (see chart).

On the 10th day there is, associated with a further change of diet, a further increase of 85 grs in Urea output. The total daily amount is now above normal.

From this day there is a tendency to decrease. This decrease is slight on 11th day, probably because the fall, which, from our recollection of the appearances in Case VI. we should have expected, is partly counteracted by the results of a further slight addition to the diet - an egg was allowed on this day.

The following (12th) day there was no further change in diet, and the fall in Urea output is more marked. The total daily amount is about normal.

On 13th day there is a great upward jump in the total daily amount of Urea output. Chicken VI ozs and Bread $\overline{3}$ IV s. were added to the diet on this day.

The effect of this addition has worn off by the following (14th) day. "Equilibrium" appears to have been regained rapidly. This appearance is in accord with those seen in other cases, when the dietary /

dietary additions are made gradually. On the 14th day, when no change in diet occurred, the fall away in Urea output is marked. The amount of output on the 14th day (300 grs) represents a decrease of 278 grs from the amount noted on the 11th day, and the total output on the 12th day is 86 grs less than on the 11th. Supposing the change of diet on the 13th day had not occurred - with its associated effects as regards Urea output - it is possible that a steady and regular decrease till the end of the 14th day might have been observed, for the difference in total amount on the 12th day from the total amount on the 11th is almost exactly one-third the amount of the difference in total of the 14th day from the 11th day. In other words - leaving out of account the increase in Urea on the 13th day due to the dietary change - the average daily decrease for the 12th, 13th, and 14th days would be about 90 grs.

On the 15th day, again, there is an increase of 134 grs in Urea output. The change to 'light diet' on this day involves only additional amounts of the articles of diet given on the previous two days. (The various quantities were not noted, unfortunately).

On /

On the 16th day (when the diet remained unaltered) there is again a marked fall in the total Urea output to 263 grs per 24 hours. This is the lowest amount noted for any single day during convalescence. Whether the rise of temperature witnessed on this day had any effect on the output, I am unable to say.

On the 17th day, there is an increase of 117 grs in Urea output. Whether some of this increase may have followed the short critical fall in temperature on that day, I am unable to state.

The increase in daily total output is, however, continued on the 18th day. The amount of the increase (40 grs) brings the total Urea for that day to very near the normal.

Here then there is evident :-

A marked post-critical rise to well above normal in Urea excretion. This lasts about 12 hours.

Then a fall in Urea output, lasting 24 - 36 hours. This is followed again by a marked increase in daily output: the increase is maintained for 2 days, till end of 10th day. From this point a downward incline in total daily Urea quantity for 2 days (11th and 12th days) the Urea reaching about normal on the second day. There is a great upward /

upward jump in total daily Urea output on the next (13th) day - associated with change of diet. From this point, again, there is a prolonged downward oscillation extending over 5 days. The climax of the oscillation is reached on the 16th day. A brief daily upward oscillation, consequent on dietary changes, occurs in course of this great oscillation (on the 15th day).

Probably the most striking feature throughout this study is the evident re-action to dietary alterations.

The direct, though not proportional, relationship between the amount of Urea and Urine, has been remarked upon.

Urea percentage. There is a high per centage during the period of post-critical rise (3.8%), and a fall (though still above normal) to 2.8% in the period immediately following. From this time onwards for six days the percentage is sustained above normal, showing a fall of only 0.1% in that time. It is probable that, as suggested before in Case VI. the daily fall in percentage would have been greater had the dietary changes not occurred on these days. For we have seen that there is almost invariably a temporary /

temporary increase in percentage with a change of diet in early convalescence. The increase which might otherwise have been seen here is negatived by the tendency which the percentage has to return to normal - which involves a progressive decrease in percentage.

When any further definite dietary alteration ceases, there being presumably no further cause for a sustained percentage, the fall in percentage is sudden and marked. There is a fall of practically a whole unit of percentage (i.e. from 2.6% to 1.7%).

There is a further slight regular fall for 2 days, the day of lowest Urine and Urea (16th) also showing the lowest percentage.

From that point there is a sudden increase in percentage to about normal. Judging by the almost entire absence of physical signs, and the return of the respiration rate to about normal on the afternoon of the 18th day, the Urine may be considered to be almost normal on that day.

On the 18th day, then, the normal state is practically reached, i.e.

Total /

	Total in this case.	Average in health for this age in a male.
Urine	47 oz	45 - 55 oz
Urea	420 grs	450 - 550 grs
Urea %	2 %	2 %

To sum up in this case then, there are seen :-

- (1) A post-critical period of 12 hours immediately following on the completion of the crisis; during this period there is an excretion of Urea and Urine far above normal. The percentage of Urea is unusually high, showing that the increase in Urine is not proportional to increase in Urea output.
- (2) A decreased output of Urea and Urine for a brief period (about 24 - 36 hours).
- (3) Then a sharp increase in both Urea and Urine for 2 days associated with changes in diet.
- (4) Following this, a gradual decrease in output of both Urine and Urea for about 5 days - the general line of decrease being evident on those days when there is no dietary change. In this period daily upward oscillations, on the days which witnessed dietary alterations, are seen.
- (5) A rapid return to about normal. This rise of about normal covers a period of 2 days.

The /

The Urea percentage shows a more or less steady fall from the period succeeding the post-critical rise. The fall is very slight during the period when dietary changes are occurring, (A similar appearance seen in Case VI.) but there is a sudden very marked fall away in percentage after change has ceased. The fall would no doubt have been more regular had there been no dietary change. There is a downward subnormal oscillation in percentage for 3 days towards the end, and then the normal is suddenly gained during the last two days of observation.

There is no evident relationship between the amount of Urea output and variations in temperature and pulse.

The patient went to the Convalescent Home on the 19th day after onset.

The Leucocytes were not done in this Case.

The pulse relation to temperature is similar to the relationship seen in previous cases. The normal is not reached for about 32 - 36 hours after the crisis is complete. It becomes subnormal for a time, but gradually rises to about normal in the last few days. Its oscillations are not often in accord with the oscillations in temperature. It bears no definite relation to the amount of Urea excretion.

The /

The respirations show the usual gradual fall towards normal from the period of crisis in temperature.

The rate of their return to normal (18 per min) appears to keep pace more or less with the rate of the process of resolution and the return of the Urea and Urea percentage to normal. No other definite relationship is apparent between Respirations and Urea excretion. A relationship to the variations in temperature during convalescence is not evident.

CASE VIII A CASE with a HIGH UREA OUTPUT on the LAST DAY of the
FASTIGIUM, and NO APPARENT POST-CRITICAL RISE.

Daniel McAlister. 16 years. Admitted G.R.I.
 6/4/1907.

Illness began 1/4/1907. Says no rigor that
 he can recollect.

Symptoms. Cough and tenacious spit began that
 evening. Was feverish that evening. Anorexia.
 No vomiting. Soon after cough began, patient com-
 menced to experience catching pain in right side
 of chest in front, just below nipple area, and at
 the side low down in mid-axillary line.

Saw sputum rusty next day. Moderate amount
 of sputum.

There was very little sweating at any time.
 Never diarrhoea.

Albumen was present in the Urine to the extent
 of a faint haze on the 6th, 7th, 8th, and 9th days
 of illness.

On admission, physical signs indicated con-
 solidation of Right Lower Lobe from base to apex,
 and extending to about mid-axillary line in front.

A critical fall of temperature began between
 8 and 12 a.m. on 7th day.

A 'break' in the fall occurred between 8 and
 12 p.m., the upward tendency lasting about 4 hours.
 From that time fall in temperature continued, and
 crisis was complete between 4 and 8 a.m. on 8th day.
 Resolution was progressing fairly rapidly when ob-
 servations ceased.

For diet, etc., see Chart.

Consideration/

4 HOUR CHART.

DISEASE.

Pneumonia

RL Lobe (base to apex & to ^{UREA %}
midaxillary line in front)

Name { Daniel
McAlister

Age 16 years.

Diet su chart

Case Book N^o

Notes of Case

Onset 1.4.04

Says no rigor so far
as he remembers. Not
does he remember headache

Cough & sticky spit
began in evening

Pain in front of rt side
of chest below nipple
and at side in mid a
line low down.

Felt feverish same evening
Saw spit rusty next day.

Little Sweating at any time
no alcohol no diuretics

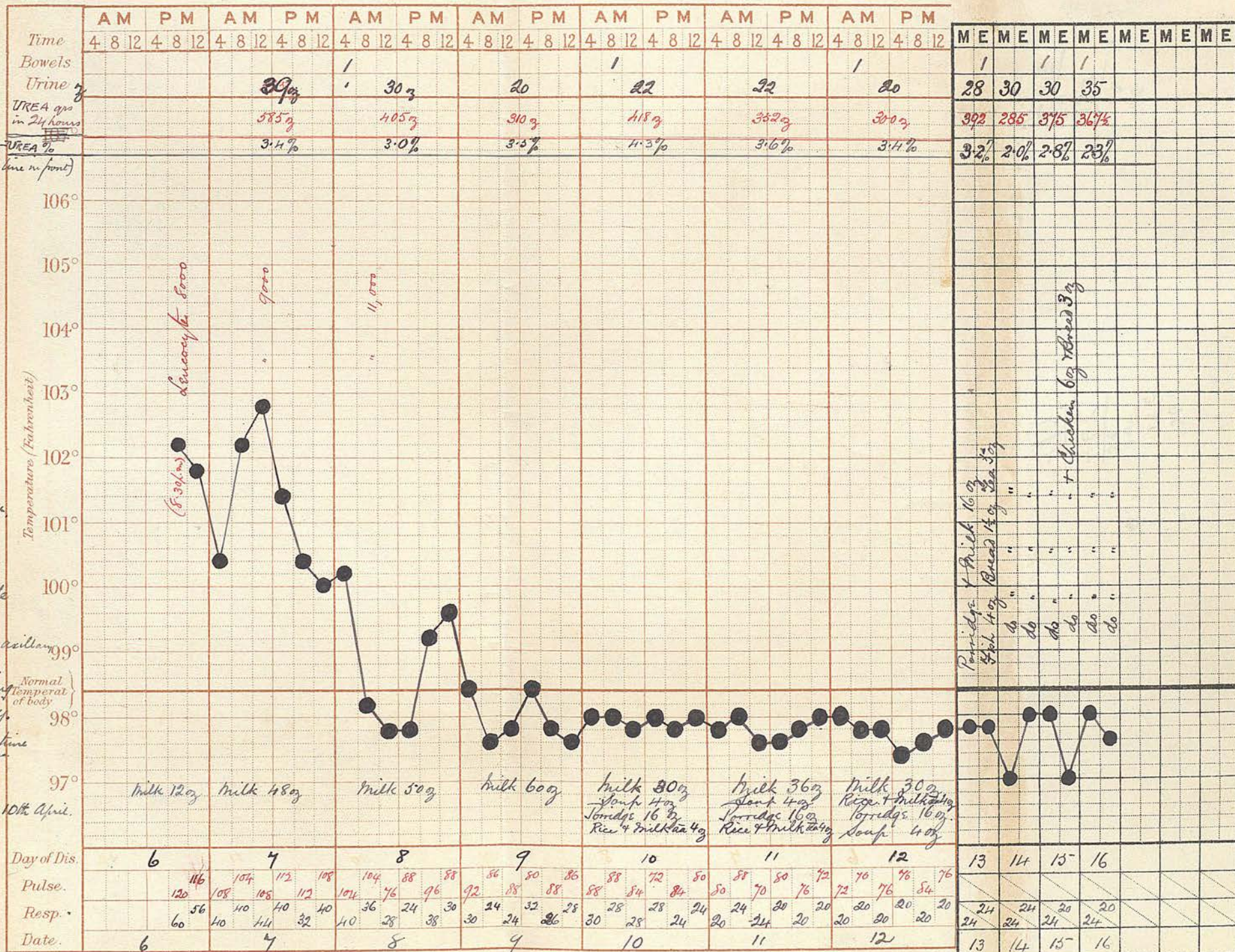
Albumen a faint haze on
6th, 7th, 8th & 9th. Absent on 10th April.

Resolution fairly rapid.

Date of admission

6.4.04

Result well



The chief reason which has influenced me in introducing this case into the series at all, is the apparent absence in it of a post-critical rise of Urea and Urine. The amount of Urea excreted on the day of completion of the crisis (405 grs) is certainly very considerable, and greater than the amount excreted at the period of post-critical rise in some previous cases; but it represents a reduction of 180 grs on the total for the previous day.

It will be observed, however, that there are two distinct falls of temperature at different periods on the 7th day here. Each fall has its termination on this day, and therefore from our knowledge of previous cases we should have expected an increase in the amount of Urea excreted on this day. Whether the first fall (6th and 7th days) was very great or not, it is impossible to say, so that it is also impossible to surmise whether the increase in Urea excretion which probably followed its termination was great or small.

Regarding the second fall, it will be noted that its termination occurs within the 4-hourly period immediately preceding the beginning of the next 24-hourly period(i.e. 8th day). This being so, a recollection of appearances in other cases

e.g. /

(e.g. Case II.) would have led us to expect an increase lasting for from 8 - 12 hours immediately following the termination of the fall in temperature. A part of the increased Urea excretion would then appear on the 8th day. This, added to the post-critical rise which we should naturally expect to find on this (8th) day, would have led us to expect an increased Urea output on this day also. But instead, we witness a reduction of 180 grs, as compared with the previous day. If this case is not to be regarded as of quite a different type from all the others, the only possible explanation seems to be that the increase in Urea output may have begun in the second last 4-hour period of the 7th day, when the fall of temperature is practically completed. This would put, by far, the greater part of the Urea increase, occurring after this fall, into the 24-hour period of the 7th day, and the two increases on the 7th day might then easily account for the appearances seen on the 7th and 8th days.

In Convalescence there is a renewed rise of temperature on the 8th day. It is possible that this has something to do with a reduction of the Urea output on the latter half of this day - thus counteracting the amount of a post-critical rise which /

which may have occurred previously, but I am inclined to think that we are dealing in this case, not with an unusual reduction on the 8th day, but with an unusual increase for some reason on the 7th day, connected in some way, not apparent, with the 2 falls in temperature.

The alternative suggestion is, that this is a case which has had a high fastigial Urea all along, and that there is a post-critical fall in output instead of the post-critical rise usually seen in other cases. But we have seen that the post-critical rise is quite as apparent and proportional in the Case with high fastigial Urea as in others. (See Case VI. and cf. Cases I., II., etc.

It is obvious that the difference is not to be accounted for by the amount of nitrogenous diet taken. (See chart). The difficulty would, no doubt, have been cleared up by a 4-hourly estimation of Urine and Urea, but unfortunately this was not done in this case; and though I have estimated the Urea 4-hourly in a number of cases since, I have not had the good fortune to meet a similar case to this one.

There is nothing specially peculiar about the appearances in convalescence in this case, therefore they will only be discussed briefly.

The /

The Urine on the day of crisis is higher than any amount for a similar period for nearly a week following. This appearance is similar to that seen in cases with a post-critical rise. The following (9th) day the total amount is equal to the lowest daily total seen in the period of convalescence - 20 oz Urine being registered on only one other day (12th).

With the exception of this slight downward oscillation on the 12th day, there is a more or less gradual increase towards normal in total daily Urine secretion, from the 9th day onward till observations ceased.

The daily Urea total shows a fall away on the day after the crisis. There is an equally marked increase again, however, next (10th) day. From that time there is an oscillating decrease till the 14th day, when the lowest amount seen in convalescence is registered, Then there is a tendency to return to normal, which, however, is not quite reached at the period when observations ceased.

The daily oscillations seen in the total Urea output in the convalescent period, seem to be associated more or less closely with additions to the diet.

The /

The Urea percentage, while lower on the day of crisis than on the preceding day, is still high (3%). The 9th day witnesses an increase in percentage to 3.5%.

On the 10th day there is a much more marked increase to 4.3%. It is synchronous with the first of a series of additions to the diet.

In the next 4 days the percentage falls to normal. The decrease is steady and proportional till the 14th day, which witnesses a great fall (from 3.2% - 2.0%) in percentage.

On the 15th day, with the addition of Chicken to the diet, there is a considerable increase in percentage (2.8%). It had not reached normal again when observations ceased at end of the following day.

Therefore, the Urine was not in its normal healthy state when observations ceased :-

	Results for 16th day in this case.	Average in health at this age. (16 years).
Total daily Urine	35 oz	38 to 44 oz
Total daily Urea	367½ grs	450 to 500grs
Urea %	2.3%	2.0%.

The respirations were still some way from normal on the cessation of observations, and the physical examination /

4 HOUR CHART.

DISEASE.

Pneumonia

R.U. lobe. (totally involved)

Name { Thomas
Garlin

Age 33 years

Diet (see chart)

Case Book No.

Notes of Case

Onset 5.4.04.

Rigor.

Headache.

Sickness & Vomiting.

Cough & viscid spit.

Pain in rt chest low down

Little sweating;
rather more just at
beginning of crisis.

No diarrhoea

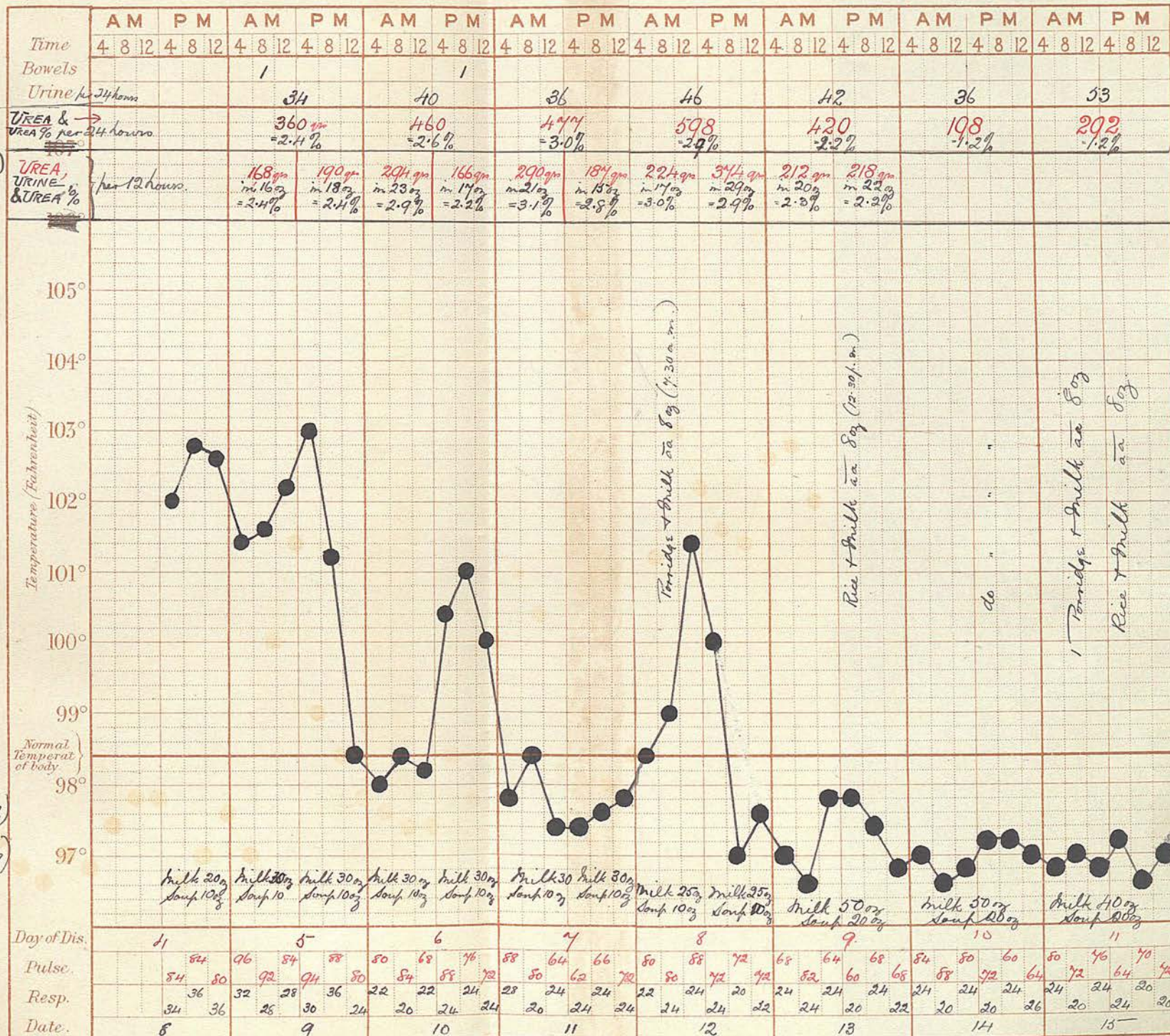
Urine - Albumen a
trace till 10th day (incl)

Resolution? (proceeding)

Date of admission

8.4.04

Result *looking well.*



CASE IX. CASE with DIMINISHED UREA on the ONLY DAY of the FAST-
IGIUM OBSERVED, and SHOWING PECULIARITIES in the
PERIOD after CRISIS.

Thomas Garlin. 33 years. Admitted G.R.I.
8/4/1907.

Illness began 5/4/1907 with a rigor.

Symptoms. Headache, anorexia, sickness and vomiting. Cough associated with a tenacious sputum began to trouble patient shortly after, also shortness of breath. Soon, also, patient began to have stitching pain in lower part of right side of chest.

Some epicritical sweating. Little sweating at any other time.

On day of admission physical signs indicated consolidation of whole Right Upper Lobe.

Temperature fell by crisis on afternoon of 5th day. There were two fresh rises of temperature - one began between 8 and 12 a.m. on 6th day reached 101° , and fell to normal again in about 16 hours. The next began between 4 and 8 a.m., 8th day reached 101.2° and reached normal again in about 12 hours. No further physical signs were observed in the lungs which would indicate the cause of these subsequent rises of temperature.

No diarrhoea.

A trace of albumen was present in the Urine up to and inclusive of 10th day. Resolution was advancing, but seemed still a considerable way from completion when observations ceased on 11th day.

For temperature, pulse, respirations, diet, Urea, etc., see Chart.

My reason for introducing this case is to show the effect on the Urea output of temperature rises here. These rises are seen in a certain number of cases after the crisis.

(a) During Fastigium.

The Urine and Urea excretion are low on the one day of the fastigium on which observations were possible. The amounts would probably have been even less had the crisis not been complete in the last 4 hours of this day, as a comparison of the two 12-hourly amounts on this (5th) day indicate that the post-critical rise in Urea and Urine was in progress before the completion of the 24 hours of the 5th day.

The Urea % is above normal on this day, though lower than usual in the fastigial period.

<u>Totals for the 5th day</u>	Total Urine	34 oz
	Total Urea	360 grs
	Urea %	2.4%

(b) During Convalescence.

The Urine. With the post-critical rise in Urea, seen on first half of 6th day, there is an increase to 23 oz in amount of Urine. The second 12-hourly period of the 6th day shows a fall to 17 oz. Whether /

Whether this reduction is associated with the higher temperature during this period, it is impossible to say; but it must be remembered that the appearance of the Urine (and Urea) here is similar to that seen in all the other cases where no such heightened temperature occurred.

During first 12 hours of the 7th day - the temperature having fallen to normal again - there is again an increase in Urine output to 21 oz. It is associated with a rise in Urea output in that period. In the second 12 hours of this day the Urine output falls to a total of 15 oz.

From this period onwards the Urine secreted varies directly, though not proportionately, with the Urea excreted - as it has done previously in other cases. There is a greatly increased Urine output on the 11th day, the cause of which it is impossible for me to state.

From the 8th day till the end of the 10th day, there is a daily decrease from normal in amount of Urine.

The Urea. A post-critical increase from 190 to 294 grs in Urea output is evident on the first 12 hours of the 6th day. Indeed, the post-critical rise may have begun some few hours earlier, as the Urea /

Urea excreted on second half of 5th day exceeds that excreted on first half of that day by 22 grains. This state of affairs would be in accord with appearances in other cases where the post-critical rise becomes apparent immediately the normal temperature is reached in the crisis.

On the second half of the 6th day the Urea output shows a decrease of 128 grs. This appearance is exactly similar to that seen in previous cases immediately after the completion of the post-critical rise. Whether the amount is affected in any way by the heightened temperature during that period, I am unable to state.

On the first 12 hours of the 7th day - the period witnessing the return of temperature to normal - there is an interesting appearance. This is a temporarily increased Urea excretion following a critical fall of temperature in this period. That it is a result of the fall of temperature is more than possible. It is certainly not due to the diet, as the diet up to this time remained the same in all the periods here, except on the first half of the 8th day. It must be admitted, however, that a similar increase occurs at about this period in every one of our previous cases. In all these, the increase is ascribed to a change in diet, but no such /

such change was made in this case - on account of the rise in temperature. It is just possible that an increase in Urea output may be the usual occurrence about this period in all cases, even without the added results of a dietary change.

The second half of the 7th day witnesses a marked fall away in the Urea output.

Over the first 12 hours of 8th day there is an increase of 37 grs over the previous 12 hours. The temperature rises rapidly to 101.2° in this period. Porridge and milk $\bar{a}\bar{a}$ 8 oz were given about 7 a.m. i.e., before the 8 a.m. temperature was noted. Nothing but milk and soup were given after this till 12.30 p.m. next day.

The moderate increase of Urea output in the above mentioned period is possibly due to this inadvertent change in diet. Whether the amount would have been greater or less had the rise of temperature not occurred, I am unable to state.

In the second half of 8th day we see again a similar appearance to that seen at the end of the previous fall of temperature on 7th day - only the actual increase in Urea output is greater than at that time, the actual increase being then 124 grs, whilst now it is 150 grs more than in previous 12 hours /

hours. The reason for the greater amount of this increase may be partly the more extensive nature of the critical fall compared with the previous one - though in previous cases at the time of the crisis, - the extent of the fall does not appear to affect the relative amounts excreted, and partly a consequence of the addition of porridge to the diet in the previous 12-hourly period.

Whatever the cause of the increase may be, it is apparent that there is an increase synchronous with this fall of temperature.

The total amount of Urea noted on the 1st 12 hours of the 9th day, though representing a marked fall away from the total of the previous 12 hours, yet is considerable.

The first 4 hours of this period is also part of the period covering 8 or 12 hours after the completion of the fall of temperature on the previous evening, and no doubt the amount of Urea noted would have been less than it is had this not been the case, for as has been seen previously, the increase in Urea output after the completion of a temperature fall, usually lasts about 8 to 12 hours.

There is a slight increase to 218 grs on 2nd half of 9th day. This is no doubt due to the addition of Rice 8 oz to the diet. The increase is small, but the reason probably is that part of the increase is swallowed /

swallowed up in counteracting a fall which we should have expected to see at this period had nothing occurred to upset the equilibrium.

On the next (10th) day, there is a very marked fall in total daily Urea output, which amounts only to 198 grs for the whole 24 hours. There was no dietary addition on this day.

On the 11th day, an increase of nearly 100 grs in the daily total Urea occurs. Porridge was added to diet. This is, however, possibly the beginning of an upward incline in daily Urea towards normal, independent of dietary additions, similar to what is seen soon after the crisis in some previous cases.

The Urea thus appears to be rather slower here than usual in returning towards normal after the true crisis. It again therefore appears to keep pace somewhat, with the rate of the process of resolution, and the return of respirations towards normal. They had all some way to go yet, before they could be considered to be about normal.

The Urea percentage.

- (1) There is seen here, an increased percentage (2.9%) during the period of the post-critical rise of the Urea and Urine.
- (2) During the next 12 hours, the % falls to 2.2%, despite the return of pyrexia during that period.
- (3) /

- (3) Another increase to 3.1% occurs in the 12-hourly period following the completion of the fall in temperature at the beginning of the 7th day.
- (4) This is again followed by a fall to 2.8% in next 12-hourly period.
- (5) Again there is an increase to 3.0% concomitant with a change in diet and a further period of pyrexia.
- (6) The percentage is fairly well maintained till the increase in Urea output, which occurs after the fall in temperature on 8th day passes off.
- (7) From that time there is a sharp and sustained fall in percentage for 48 hours or so, despite dietary additions. The fall is most marked, however, in the periods when no dietary changes were made.
- (8) The Urea % was far below normal when observations ceased, but, as it had been stationary for 2 days, it is probable that a gradual increase towards normal, such as was seen in other cases, set in at this point.

The Urine in this case contained albumen from the day of admission till the 10th day (inclusive).

Considering the Urea in this case then, we observe :-

- I. The Urea to be subnormal in last day of fastigium.
- II. A post-critical rise in Urea and Urine output lasting about 12 hours or so.
- III. Temporary rises in Urea and Urine output, following the critical falls of temperature on 7th and again on 8th days.
- IV. /

- IV. That from this period onward, appearances are very similar to those seen after the crisis in an ordinary case, i.e., a temporary fall in Urea output, and then an increase again.
- V. So that, altogether, it would appear as though these brief exacerbations of temperature - whatever their nature - have delayed the commencement of the upward incline in daily Urea output towards normal; which upward incline is the appearance invariably seen in previous cases with a low Urea excretion immediately after the crisis.
-

The relation to the process of resolution and to respiration rate has been remarked on above.

It is a noteworthy fact that the pulse and respirations appear to be very little influenced by the two rises of temperature seen in convalescence, otherwise their relationship to temperature is very similar to what has been observed in previous cases.

The Leucocytes were not done daily in this case.

CASE X.

CASE SHEWING APPEARANCES ASSOCIATED with a FALL of
TEMPERATURE by LYSIS.

Mrs Ellen O'Donell. 43 years. Admitted G.R.I.
 6/4/1907.

Illness began 2/4/1907 with a rigor in the morning.

Symptoms. Headache and Anorexia. No feeling of sickness. No vomiting. The same day began to have a cough. This was soon associated with a sticky sputum. Shortness of breath soon became troublesome.

That afternoon first noticed severe pain in right side of chest, just above right nipple and extending into upper part of axilla.

Never any marked sweating till lysis began. Then some sweating constantly till fall of temperature complete.

On day of admission physical signs indicated consolidation of whole Right Upper Lobe.

Temperature shewed a fall by lysis. Whether the fall began prior to admission or not, it is impossible to determine. The temperature was somewhat irregular in places, but on the whole fell steadily, i.e., from 103° at 4 p.m. on 4th day of illness (day of admission) till 4 p.m. on 8th day, when it first reached normal. The lysis thus occupied exactly 4 days from the time of admission.

During the fall of temperature, there were three marked departures from the steady downward trend of the pyrexia. These were (1) a marked critical fall of temperature from 101.4° to 98.6° on the 5th and 6th days; (2) a sudden rise of temperature from 98.6° to 101.8° , followed immediately by a fall to 99.4° on 6th day; (3) a somewhat slower rise from 99.4° to 101° on 7th day. This again is immediately followed by a more gradual fall to 99° on 7th and 8th days.

The effect of these variations of temperature on Urea excretion will be discussed in this Case.

Albumen /

DISEASE.

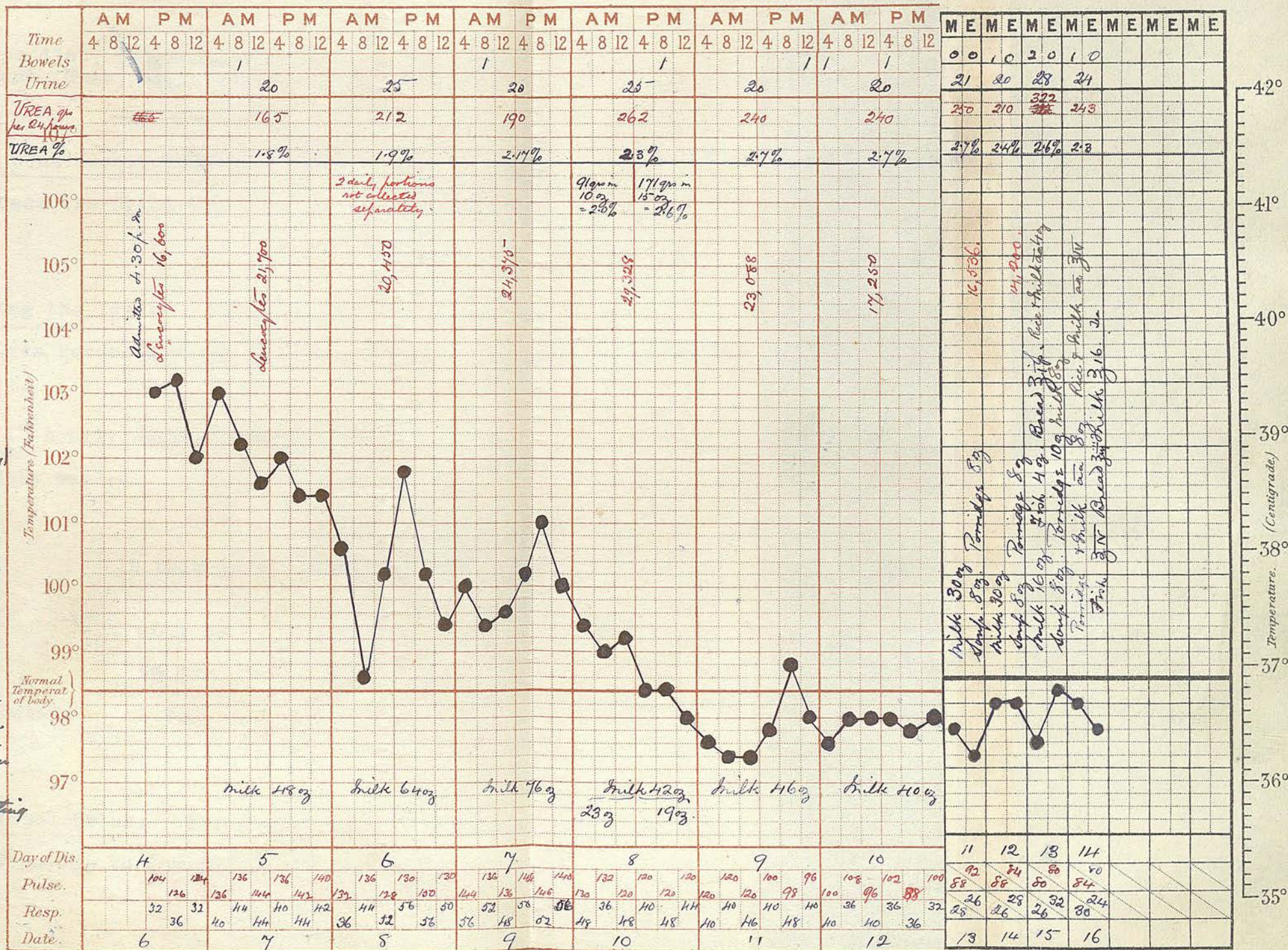
Notes of Case

Albumen abundant
in urine till 6th
day of illness. Next
day a distinct trace
& gradually less from
then till 12th day when
gone.

never marked sweating
Resolution advancing

Date of admission
6.4.07

Result



Albumen was abundant in the Urine till the 6th day of illness. Next day witnessed a reduction to "a distinct trace", and the daily amount gradually decreased till the 11th day (the latter inclusive). Albumen absent on 12th day. Thus the Urine was albuminous till 3 days after the temperature reached normal.

(For diet, temperature, pulse, respirations, blood count, Urea, etc., see Chart).

The Consideration of this Case. Unfortunately in this Case the Urine and Urea were not noted four-hourly.

During the Lysis. The average daily Urine, Urea, and the Urea Percentage are all low during the $3\frac{1}{2}$ days of lysis.

The 12-hourly average over 7 such periods till end of lysis was :-

	In this Case.	Normal average for 12 hours in health in a woman of this age.
Urine	10.7 oz.	About 20-25 oz.
Urea	94 grs.	About 225 grs.
Urea Percentage	1.96%	2%.

The Total Urine. There are variations in the quantity from day to day during the period of lysis.
The /

The different amounts vary directly, though not proportionately, with the amount of Urea excreted in the same periods.

They have no apparent relation to temperature other than that which the Urea bears. (This will be discussed later).

They certainly do not appear to depend on the amount of milk taken (see Chart).

The Total Urea. This as we have seen is very low during the period of lysis.

Relation to Temperature. The total Urea in each daily and in the one 12-hourly period obviously does not vary, either directly or inversely, with the average degree of temperature in the same period, e.g.,

	Temp. average over the six 4-hourly periods of each day.	Total daily Urea	Urea Percentage.
5th day	101.9°	165 grs.	1.8%
6th day	100.3°	212 grs.	1.9%
7th day	100°	190 grs.	2.17%
1st 12 hrs. of 8th day (3 4-hrly. periods).	99.2°	(for 12 hours) 91 grs = (182 grs per 24 hrs).	(for 12 hours). 2.0%

There /

There is in this case no evidence of a gradually increasing Urea excretion, associated with the more or less gradual fall in temperature. It is possible that such an appearance might have been seen had the departures from the steady line of descent of temperature seen on the 6th day, not occurred, for the daily amount is greater towards the end than at the beginning of the lysis. However, as the irregularities in temperature just mentioned seem, as we shall see, to have an effect on the amount of Urea excretion on the 6th and 7th days, it is impossible to reach any definite conclusion on this question from a study of this Case.

There is, however, a relationship to temperature which is in accord with what we have seen in previous cases.

The 6th day witnesses the completion of two marked critical falls of temperature. The first fall should be especially noted, as it is the greater of the two, follows a period of gradual decline in temperature, and has thus the appearance of a pseudo-crisis in the course of the lysis.

This fall extends over a period of about 8 hrs. (12 p.m. on 5th day to 8 a.m. on 6th day). It covers 2.8 degrees of temperature.

The /

The second fall is part of a great oscillation following the fall just discussed. It covers 2.4° of temperature, and extends over a period of about 8 hours.

Now on this day let it also be noted, the total amount of Urea noted is the highest recorded daily excretion during the lysis. I am of opinion that the increase on this day is consequent upon the completion of these falls of temperature occurring on this day, (but especially the first one), for the following reasons :-

(1) One of the most striking facts which has been observed in previous Cases, e.g., Cases I, II, and VI, is that a fall in temperature, of the nature especially of that occurring on first half of the 6th day, is practically invariably followed by a temporarily increased output of Urea.

The appearances seen on the 9th day in Case I, on the 11th day in Case II, and especially on the 8th day in Case VI, are almost exactly similar.

(2) If the increased Urea output on that day were due to the rise of temperature seen on this 6th day, we should be here dealing with a complete anomaly so far as our previous experience goes - for a similar appearance is not recorded in any previous Case.

Another /

Another, though somewhat gradual, rise of temperature is noted on following (7th) day. On this day, the total Urea is 25 grs. higher than on the 5th day, when there was no marked departure from the general line of temperature descent. It may be suggested then, that here we have a rise in temperature associated with a relative increase in Urea, but it is more than probable that the increase is a sequence of the termination of the fall of temperature, which occurred during the last 4-hour period on the previous day.

It is possible that with any steady lysis there is a gradually increasing daily output of Urea, and part of the increase we are discussing may indeed, therefore, be due to such a cause, but the fact that a post-lytical rise is seen, and that in no other case do we see an increase till fall of temperature is complete, makes this view appear rather improbable.

I am of opinion, then, that the increased Urea output on 6th day is chiefly due to a temporary increase following the fall in temperature first discussed (i.e., in first 12 hrs. of 6th day), and possibly partly to a temporary increase following the termination of the fall of temperature last discussed (i.e., on 2nd 12 hours of 6th day). The increase after this latter fall, I believe to be continued into the earlier hours of the 7th day, thus accounting for /

for some at least of the relative increase on that day over the amount noted on 5th day.

In the first 12 hours of the 8th day, the Urea excretion is 91 grs. This gives an average for the whole day of 182 grs., which represents a very slight decrease on the total amount for the 7th day.

Relation to Diet. It is at once obvious from a consideration of the daily amount of diet that the Urea excretion is in no way definitely related to the amount of diet taken in the same period during the whole period of Lysis (See Chart).

Relation to Urine. This has already been noted.

Urea Percentage. The average percentage is low during the period when the Lysis is occurring.

Only on the 7th and first half of 8th day is it up to normal. There is a steady increase in percentage for the three complete days during the Lysis.

Whether the Urea percentages for the 6th and 7th days are greater or less than they would have been had the two falls in temperature, which we have just discussed, not occurred, it is impossible to say. In Cases I and VI, however, there is a temporary fall in percentage associated with a pseudo-critical fall, such as is seen in the first 12 hours of the 6th day in this Case.

The /

The daily percentage in this Case appears to vary inversely, though not proportionally, with the average daily temperature, except in the last 12 hours of the period of Lysis. (See Table page 136).

The percentage does not appear to depend on volume of Urine in any way.

Nor does it appear to vary inversely as the amount of Urea or Urine.

During Convalescence. The temperature touches normal at the beginning of the 2nd 12-hourly period of 8th day. In this 12-hourly period there is a marked increase in Urine, Urea, and Urea percentage, i.e.,

Urine	-	15 oz.	} in 12 hrs.
Urea	-	171 grs.	
Urea Percentage		2.6%	

This is a marked increase on the 12-hourly average amount during the Lysis (cf. p. 135 Table).

A 24-hour average taken from the above gives the following figures :-

Urine	-	30 oz.
Urea	-	342 grs.
Urea Percentage		2.6%

This /

This is the highest average in total Urine and Urea for any period of 24 hours either previously or subsequently.

This appearance is exactly similar to that seen immediately following the return of the temperature to normal in Cases where the temperature fell by Crisis; so that it would appear (it is so in this Case at any rate) that a temporary post-lytical increase in Urea and Urine may occur in Pneumonia as well as a post-critical one, and very similar in appearance and duration to this latter. This appearance is very interesting.

The rise cannot be accounted for by the amount of the diet, as that appears to be actually less in quantity in this period than at any other time during the fall of temperature.

From this point onwards, the progress of Convalescence is much as in other Cases.

The total daily Urea and Urine shew a slight fall the day following the post-lytical rise.

Till observations ceased, the amounts of total daily Urea and Urine oscillated irregularly - the upward oscillations appearing to depend chiefly on dietary alterations - but no definite tendency either to a continued decrease or increase in the amount of either is evident. But as the Chart takes us to the /

the 6th day after the fall of temperature to normal, we must conclude that the return to normal will be completed relatively later in this Case than in nearly all our previous Cases (excepting possibly Case IX).

The process of Resolution seemed still a considerable way from completion in this Case when observations ceased, and the Respirations were still considerably above normal. In this Case also, then, so far as we can judge, there appears to be some relationship between the rate of return to normal of the Urine, Respirations, and the affected portion of lung.

The Urea percentage shews a minute increase (to 2.7%) on the day following the post-lytical rise. A fall in percentage is generally seen at a similar stage to this in Cases where the previous rise was post-critical. From that time onward, however, there is a tendency for the percentage to decline towards normal. The decline is made to appear oscillating and irregular by the effects of dietary change, in one instance (11th day) there being a sustained percentage (2.7%) and in the other (13th day) an upward oscillation (to 2.6%) for the day.

A consideration of the Urea excretion in this Case then shews :-

(I) A low average daily Urea output during the whole of the Lysis, but higher towards the end than at beginning of observations.

(II) Variations in daily output, the increase on 6th and 7th days probably depending on certain falls of temperature on the 6th day.

(III) A very definite temporary post-lytical increase.

(IV) A return to normal, apparently slower than in Cases ending the fastigium by Crisis,

(V) But a Convalescence otherwise similar to previous Cases.

(VI) A subnormal Urea percentage in the earlier part of the Lysis, but gradually rising as the Case proceeds.

The Leucocytes. In this Case, the relation of the leucocytes to the fall in temperature is not at all so close as in other Cases. The daily leucocyte count shews a fall by Lysis in the direction of normal. The fall is still far from complete on 12th day (4 days after return of temperature to normal). The amount /

amount of leucocytosis shews no close relationship to the amount of Urea excretion throughout.

The Pulse shews a fall by Lysis from the 8th to the 13th day inclusive, the fall occurring later, therefore, than the Lysis in temperature. The four-hourly pulse variations do not shew any close relationship to the variations in temperature. The pulse had not reached normal when observations ceased. The relationship of the average pulse rate to the amount of daily Urea excretion is not so evident as that of the temperature.

The Respirations shew a fall by Lysis, apparently beginning about 10th day, and thus beginning even later than the fall in pulse rate. The respirations were still a considerable way from normal when observations ceased. The relation of rate of return of the daily Urea and respirations in the direction of normal and the rate of the process of resolution has already been remarked upon.

There is not evident any close relationship between the rate of respirations and degree of temperature or the daily average respiration rate and the daily amount of Urea excretion.

Observations on the Urea, Urine, and Urea Percentage
in the four-hourly periods :

- (1) During the Fastigium.
- (2) At the period of Crisis.
- (3) During Convalescence.

Five Cases are appended in which the four-hourly appearances were carefully studied. The greatest care was taken in these Cases to make the results as accurate as possible. The temperature, pulse, and respirations were noted exactly at the termination of each 4-hour period. The Urine was collected at the same time, and the Urea estimated under the conditions noted in the introduction to this Thesis.

The Cases on which observations were made are :-

- (1) James Cavanagh (Case VI of previous Series)
- (2) Gerald Stephen (Case I of previous Series)
- (3) Daniel Desmond (A Case not previously considered).
- (4) Walter Semple (Case III of previous Series. This Case allows of comparison being made with temperature, but not with diet).
- (5) Joseph Biondi (Case II of previous Series. Principally for observation at time of Crisis and during Convalescence).

A. The four-hourly periods in the Fastigium.

I. The Urine. We shall first inspect the twelve four-hourly periods composing the 6th and 7th days of illness in Case (1). (The 8th day will not be considered at present, because of the effect which the pseudo-crisis has on the Urine and Urea excretion on this day).

	Temp.	Urine (oz.)	Urea (grs.)	Urea %.	Milk (oz.)	4-hourly periods.
6th day	101.2°	5	87	4%	12	12 pm - 4 am
	100°	6	112	4.3%	12	4 am - 8 am
	100.4°	6	118	4.6%	14	8 am - 12 am
	100.4°	6	139	5.3%	16	12 am - 4 pm
	102°	5	113	5.2%	22	4 pm - 8 pm
	102.8°	5	98	4.5%	12	8 pm - 12 pm
7th day	103.2°	7	125	4.1%	10	12 pm - 4 am
	102.4°	4	70	3.9%	8	4 am - 8 am
	102.4°	8	143	4.1%	9	8 am - 12 am
	101.4°	8	149	4.3%	10	12 am - 4 pm
	101.6°	8	143	4.1%	14	4 pm - 8 pm
	100°	7	119	3.9%	16	8 pm - 12 pm

Relation to Temperature. It is evident from a comparison of the different columns in the above Table that the four-hourly variations in the amount of Urine are not in any ratio, either direct or inverse, to the degree of temperature in :-

- (a) the same period,
- (b) in the four-hourly period immediately previous.

The Urine is measured in 'Ounces'. As the ounce is a relatively large unit of measurement, only the more considerable variations in amount of Urine are /

are made apparent by its use. This difficulty was not foreseen when investigations were being made.

In this case, however, (and in nearly all the other appended Cases) there are considerable temperature variations without correspondingly marked variations in the quantity of Urine. But the contended absence of definite relationship is proved by the observation that, while in some instances the quantity of Urine shews an increase while the temperature falls or is down, (e.g., 1st half of 6th day), in other instances the reverse is seen (e.g., 2nd half of 6th day and on 7th day).

Relation of Urine to Diet. What has just been said regarding the apparent lack of relationship to temperature applies almost exactly to the question of diet, - which always implies 'milk' in the fastigium in this and following Cases. This lack of relationship is especially evident on the latter halves of the 6th and 7th days in this Case (Case (1)).

Effect of diet and temperature considered together.

Nor does any possible association of diet and temperature - dual reduction, dual increase, or increase of one factor associated with reduction of the other /

other - stand unconfuted of a definite relationship even in the brief period under consideration.(cf.Table p.148)

Relation to Urea Excretion. The only definite appearance observed is the direct relationship between the total amount of Urine and total amount of Urea in the four-hour periods. This relationship, however, is anything but proportional, which statement is evidenced by a comparison of the Urea percentages in the four-hourly periods.

Nor, so far as it is possible to judge, does the lack of proportion between Urine and Urea output in the various four-hour periods, appear to be accounted for by taking into account the amount of milk taken, or the degree of temperature, in each period; or both considered together. For instance, on the last three four-hour periods of the 7th day, it appears that with a gradually decreasing temperature, and, synchronously, a gradually increasing intake of milk, the percentage shews a gradual decline (i.e., the Urine excreted shews an increase proportionally greater than the increase in Urea excreted). But the relationship which this may suggest is directly confuted in the first three four-hourly periods of the same (7th) day. For every possible association of the three factors (Urine, temperature, and diet) there is, in more than one of the periods, a direct confutation.

4 HOUR CHART.

DISEASE.

Pneumonia
rower $\frac{1}{2}$ L.L.L.

Name { Gerald
Stephen

Age 16 yrs

Diet

Case Book No

Notes of Case

Chart showing
temperature
urine
urea
urea percentage
& diet
on 6th, 7th, 8th
& 9th days.

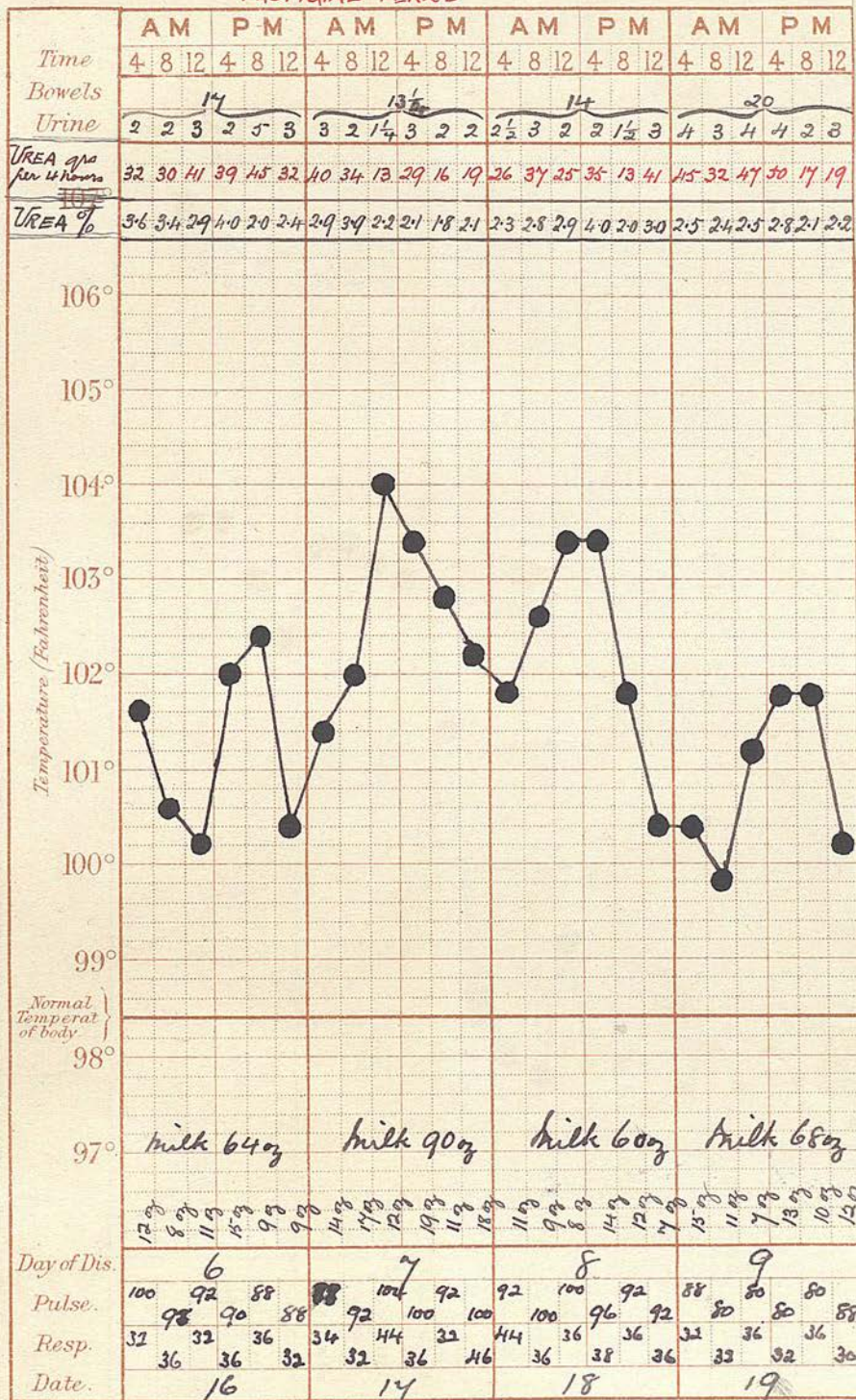
Case (2)

Date of admission

12.3.04

Result well

"FASTIGIAL" PERIOD



DISEASE.

Pneumonia R.

Case (3)

Name { Daniel
Hesmond

Age 45 years.

Diet

Case Book N^o

Notes of Case

Pneumonia

R.L.L. ? extension to
L.V. Apex.

Began - Evening - 21.3.04

Rigors

Headache

Cough

Pain (rt. chest)

Spit

Vomited 23.3.04

Sweating constant
but moderate.

Moderate drinker

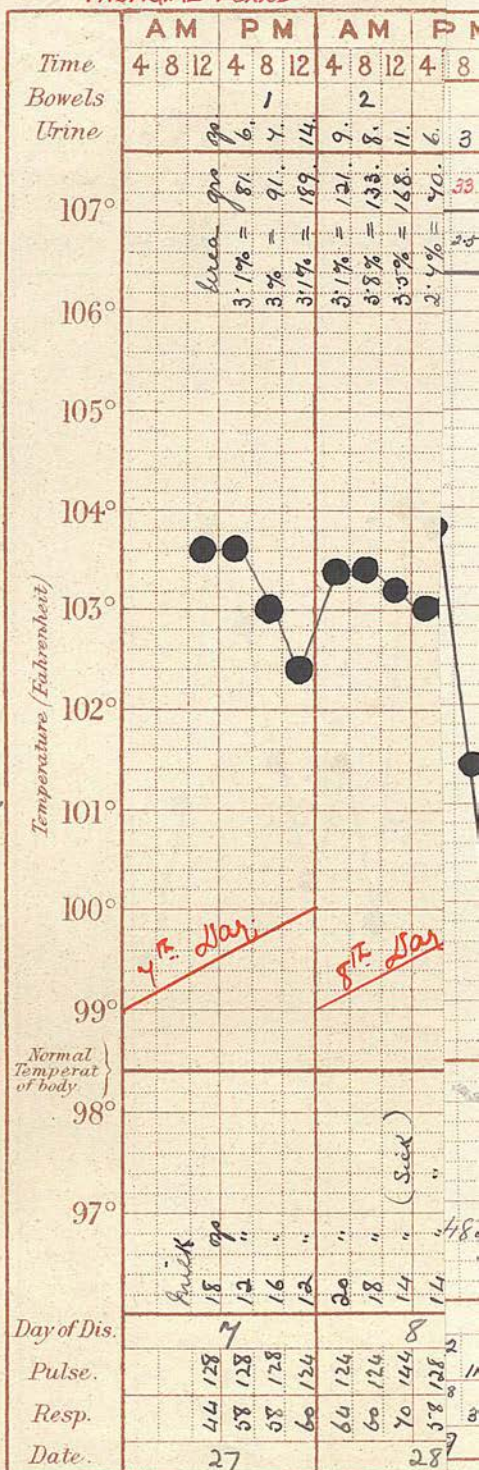
Albumen in urine - trace.
on day of admission
- none after.

Date of admission

26. 3. 1904.

Result death.

"FASTIGIAL" PERIOD



Entered at Stationers Hall.

"FASTIGIAL" PERIOD

4 HOUR CHART.

DISEASE.

Pneumonia

Name { Walter
Simple
Age 4 1/2 years
Diet (see Chart)
Case Book N^o

Notes of Case

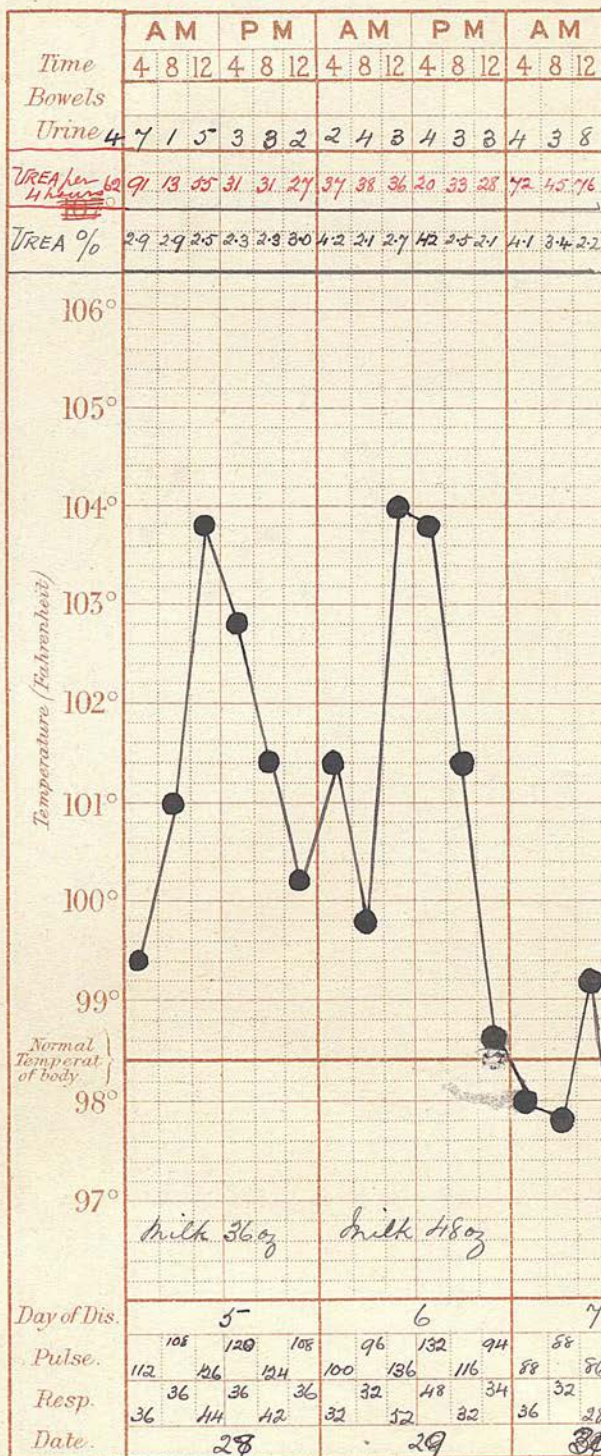
Chart showing
Temperature
Amount of diet
Urine
Urea & Urea %
in each 4 hourly
period.

Case (4)

Date of admission

27. 3. 1904

Result well



OUR CHART.

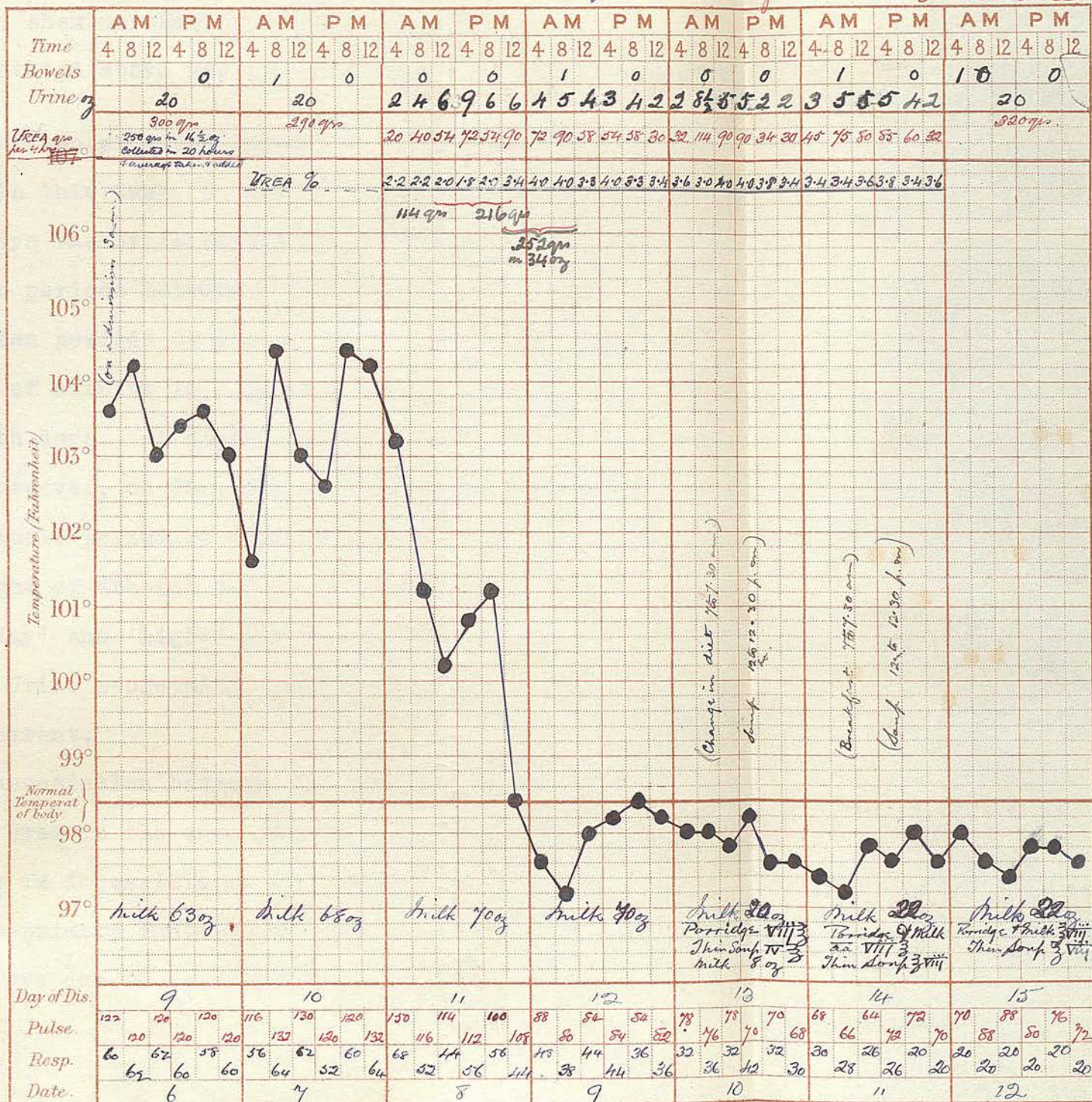
DISEASE.

Name Joseph Biondi
 Age 23 yrs.
 Diet as chart
 Case Book N^o

Notes of Case

Case (5)

To show 4 hourly Urea at time of Crisis & in Convalescence



Date of admission
6.4.04
 Result well

In other Cases. An examination of Case (2), (6th, 7th, 8th and 9th days); Case (3), (7th and 8th days); and Case (4), (5th and 6th days), (see Charts appended), shew us that, in regard to each, the conclusions stated above are all justified.

Comparison of Urine Excretion in day-time and at night. In this Case, it would appear that on the 6th and 7th days the Urine secretion is rather greater during the periods between 8 a.m. and 8 p.m. (day) than between periods of 8 p.m. and 8 a.m. (night). This condition of affairs is suggested again in Case (4) on 5th and 6th days. A direct confutation of this view is seen, however, on 7th, 8th and 9th days in Case (2), over the whole period of observation in Case (3), and on the night of 4th-5th day in Case (4). That the periods 'day' and 'night' definitely influence the amount of Urine secreted in the fastigium, therefore, is not apparent.

The association between the amount of Urine and amount of Urea in the same periods has been remarked upon. It is impossible to say, however, which of the two is the primary factor, and whether the variations in either are due to corresponding variations in the other.

In /

In this case (and in all the others appended), there are variations in the four-hourly Urine totals, as has been seen. These four-hourly variations do not conform to any evident rule of progressive increase or diminution in the progress of the Case towards its termination.

II. The Urea. A renewed examination of the Table on page 148 of this chapter will help us at this point.

Relation of Urea output to temperature.

(1) To the degree of temperature. It is evident, from a comparison of the figures under the different headings in the Table, that the four-hourly variations in total amount of Urea are not in any ratio, direct or inverse, to the degree of temperature in

(a) the same four-hourly period.

(b) the four-hourly period immediately previous.

The unit of measurement - the grain - used in the estimation of the Urea, is small, and allows of minute variations in the amount of Urea being recorded. The lack of correspondence which exists between the variations in temperature and in amount of Urea /

Urea output are, therefore, very apparent. Sometimes there is observed an increase in Urea output with a rise of temperature, rather more often a decrease (see Chart, Case (1) 5th, 6th, 7th, and 8th days); sometimes again there is a decrease in output with a fall of temperature, at other times an increase. But it is perfectly apparent that there is no constant ratio, direct or inverse, between the amount of Urea excreted and the temperature in each four-hourly period.

The increase in Urea output, extending over the 3 to 4 four-hourly periods on and after the completion of the fall of temperature on the 6th day of Case (1), dominates the field of observation on that day. Similar appearances have been discussed in previous Cases and will be referred to again later.

It appears, then, that so far as the examination of the four-hourly periods indicates, there is a lack of relationship between the degree of temperature and the amount of Urea output in these periods. It does not follow, however, that a relationship between the two does not exist. Frequent alterations in the amount of Urea excretion, and also in the degree of temperature may occur in the periods, and yet be completely unobserved owing to the relatively lengthy period of time (4 hours) between the consecutive periods of observation (i.e., times when Urine is collected and temperature /

temperature noted). It is possible that observations conducted on the lines adopted by Ringer in his observation of the Urea excretion in Ague (Trans. Soc. Med. Chirurg. 1860), - that is, at 15 minute intervals - would shew a closer relationship. But such a method of proceeding is next to impossible in Pneumonia, owing to the amount of excitement and disturbance it involves to the patient. Indeed, even the four-hourly method of observation is apt to be trying to Pneumonia patients. An hourly examination was started in one case, but the disturbance it caused to the patient, combined with the difficulty and uncertainty associated with the collection of the very small quantities of Urine (for, as has been seen, the Urine is reduced in the fastigium) forbade my going on with it. The observations did not last long enough to allow of any definite conclusions being arrived at.

(2) Relation to rises of temperature.

There is no definite evidence in this or other Cases that a rise of temperature is associated with an increase in Urea excretion as suggested by some authorities. Indications, in fact, are occasionally rather the other way, though not definitely so (e.g., last 12 hours of 6th day in this Case (Case(I)) and Case (2) 7th day). In most other instances, (i.e., excepting these two just quoted) where a rise of temperature occurs during /

during the fastigium, it follows so closely on the completion of a previous fall that the Urea increase (which we have seen to follow these falls of temperature) masks all other appearances, and no definite conclusions can be arrived at. These are almost the only two instances where the rise of temperature continues for a long enough period to allow of observations being made after the period of temporary Urea increase, which follows the immediately previous temperature fall, has passed off.

I have not been fortunate enough to be in a position to estimate the Urea output at the onset of the fastigial period in any of the series of Cases.

(3) Relation to falls of temperature.

I have shewn that a temporary increase in Urea output is seen after the more marked falls of temperature (about $1\frac{1}{2}$ degrees or more) in the fastigium and at the time of Crisis. The fact that the Urea increase always first appears in the few hours immediately following the completion of these falls, no matter how long or short they may have lasted, seems to indicate that the increase is in some way specially associated with the termination of the fall; and not merely a delayed appearance of an increase in Urea which has been going on since the fall of temperature first began. For, if the latter were so, we should in the /

the temperature falls of longer duration, expect to see the Urea increase appearing in the Urine before the fall was complete (i.e., the increase would appear always a more or less definite time after the onset of the fall, and not after its completion, as we see in these Cases.).

I see no reason in any of the Cases to believe that during a fall of temperature there is a gradually increasing output of Urea.

Relation to Diet. The absence of relationship seen between the amount of Urea and the diet in the four-hourly periods is more evident than the lack of relationship between the amount of Urine and the diet. This absence of relationship is evident throughout the whole period of observation on the days which we are considering (See Table, p. 146, of 6th and 7th days). The same is evident on other days of the fastigium in this Case; and in the fastigium in Cases (12) and (3). The remarks made above referring to the question of the possible results to be observed with a system of examination involving briefer intervals applies also to this question.

Effect /

Effect on Urea Excretion of Temperature and Diet
considered together in the four-hourly periods.

What has been said of the Urine under this heading is even more apparent in considering the Urea excretion. No possible combination - either dual reduction, dual increase, or increase of either factor, associated with reduction of the other - stands unconfuted of a definite relationship when a comparison is made over the twelve four-hourly periods on the 6th and 7th days (cf. Table p.148). The remarks made previously referring to the possible results to be obtained by more frequent periods of examination apply here also.

Relation to Urine. The relationship between the amount of Urea and Urine in the four-hourly periods has already been discussed under "Urine".

Comparison of Excretion during day-time and night.

In this Case the Urea excretion on both 6th and 7th days is greater during the 12 hours from 8 a.m. to 8 p.m. than during the other 12-hour period (8 p.m. to 8 a.m.). A direct confutation of the view that such is the regular occurrence in the fastigium, however, is supplied in Case (2) on 7th, 8th and 9th days, and over the whole period of observation in Case (3).

In /

In Case (4) the Urea on the 4th night is much higher than amount registered from 8 a.m. - 8 p.m. the following day, but that amount again is greater than amount on the following night. It does not appear, therefore, that the periods 'day' or 'night' have any important influence on the question of Urea excretion in the fastigium.

Note. One of the Cases appended (Case (3), Daniel Desmond), shews considerable regularity in the degree of temperature in consecutive four-hourly periods during the whole period of observation. In the other three Cases, the four-hourly variations in temperature are greater. These different types of cases are introduced to allow of observations being made under such varying conditions of temperature as may occur in any variety of case. The type of case shewing considerable variations in four-hourly temperature is, in my experience, very common - more so, I think, than the type often quoted as typical of Pneumonia in text-books (viz., with a temperature oscillating more or less regularly within a few points of a degree till the time of Crisis).

Again, the more marked the temperature variations in the four-hourly periods, the more striking are the results of comparison with the variations in Urea output. A temperature varying only a few points of a degree does not allow of such definite differences in /

in comparison being noted between the extent, (direct or inverse), nature, etc., of the variations in temperature and in Urea excretion, as does a temperature shewing marked variations.

So far as is made apparent by the methods employed, the results of the examination into the question of the cause of the variations in Urea and Urine output leads me to the conclusion that the factors already discussed (viz., temperature, diet, time of day, etc., considered either singly or together) do not supply a definite clue to the determining agent or agents in the amount of each excreted in the various periods.

The above conclusions are borne out in their application to Cases (2) (3) and (4)

The conclusion is forced upon me that there must be some other factor powerfully influencing the amount of Urea and Urine excretion. The nature of this factor is at present unknown to me. The solution of the difficulty may be in one or more of the following factors :-

(a) A difference in the excreting power of the kidneys at different times, with different temperatures, and with different amounts of fluid food. The amount of albumen in the Urine varies frequently, and this variation suggests that the pathological condition /

condition of the excreting cells of the convoluted tubules, which it probably indicates, varies also. The power of these cells to excrete Urea (or to perform any of their special functions) will depend on the degree to which they approach a healthy state.

(b) Variations in the amount of tissue waste at different times, and independent of temperature and diet,

- (1) throughout the body as a whole,
- (2) in special organs.

(c) The amount of sleep obtained in the various periods of the fastigium.

From observation of the different Cases, it is apparent that the pulse and respiration rate have no more definite ratio to the amount of Urea excretion than has the temperature.

These conclusions apply equally to Cases (1), (2), (3), and (4).

Differences in the amount of sweating in consecutive four-hourly periods is only marked at times. We have seen previously that the amount of Urea in the sweat is not very great as a rule. The variations in amount of sweating in other Cases are not great enough to account for the marked relative differences in amount /

amount of Urea seen in most of the four-hourly periods. Again, these variations are seen just the same in Cases where there has been little or no sweating.

The total amount of Urea lost in the Sputum and Faeces is not great in the majority of cases, and it is improbable, I think, that it can account for the great variations in Urea. It is possible that the effect on the amount of Urea of the sweat, sputum, and faeces reckoned together may be of more account.

III. The Urea Percentage. (Here, again, a consideration of the Table on p. 148 will help us.) This is observed to vary irregularly in consecutive four-hourly periods of the fastigium in all the appended Cases. These variations are more marked in some cases than in others, (e.g., Case (2) 7th and 8th days, and Case (4) 6th day).

The percentage, however, except for an occasional intermission, is above normal (2%), this fact being more marked in the Cases with high daily Urea output in the fastigium (i.e., Cases with high Urea output appear to have also a higher average percentage than others, e.g., Cases (1) and (3)).

There /

There are very occasional intermissions seen in places, e.g., Case (2) 8 p.m. on 7th day.

These are the most obvious appearances relating to Urea percentage in the fastigium.

Relation to temperature, diet, etc. There is no apparent relationship, direct or inverse, other than the above-mentioned general one, between Urea percentage and temperature in each four-hourly period.

Nor does the amount of diet considered alone, nor the degree of temperature and amount of diet considered together, in any form of association, appear to account for the variations in different periods. These assertions are borne out by an examination of the Table of 6th and 7th day of Case (1) (see Table on page 148 of this chapter), and of the Charts of the fastigium in Cases (2) (3), and (4) which are appended.

"Day or Night". It is also evident that the percentage does not vary in any regular way with the periods of 'day' (8 a.m. - 8 p.m.) or 'night' (8 p.m. - 8 a.m.) in the fastigium (*cf. Charts of (1), (2), (3), and (4)*)

Relation to Urine. The percentage does not appear to depend on the volume of Urine in the four-hourly periods.

There is no evident relationship, direct or inverse, between the Urea percentage and the total volume of Urine in each four-hourly period.

Relation to Urea. On the 6th and 7th days in Case (1) (see Table), it would appear that the percentage varied directly (though not proportionally) with the amount of Urea. This appearance is confuted in a most definite manner, however, in the periods under observation in Cases (2) (3) and (4) (See Charts appended).

There is no evidence of an inverse relationship between Urea and Urea percentage in any of the cases appended.

Relation of Urea and Urine output to certain falls of temperature of the types mentioned in Case I (Stephen) of the previous series.

The temporary increase in Urea (and Urine) output following immediately on completion of the more marked ($1\frac{1}{2}^{\circ}$ or more) falls of temperature in the fastigium has already been noted. Such appearances are evident on the 6th and 8th days in Case (1) (See Table), on the 6th, 8th, and 9th days in Case (2), in the early hours of 6th day in Case (4), on the 11th day in Case (5), and even with the shorter fall in Case (3) on 7th and 8th days.

Relation /

PERIOD OF "CRISIS"

P M			A M			P M			A M			P M		
4	8	12	4	8	12	4	8	12	4	8	12	4	8	12
Stools						1			1			1		
Urine			11			10			8			9		
Urea per 4 hours			182			175			140			137		
Urea %			4.1			4.0			4.0			4.5		

James
Cavanagh

Case (1)

To show period
of crisis
&
Post-critical
Rise on
9th day.

106°

105°

104°

103°

102°

101°

100°

99°

98°

97°

18 1/2
20
8
10
12
18
16
15
16
14

8

9

PULSE

120

120

116

100

94

100

98

92

100

RESPS

44

40

40

32

32

36

26

24

30

8

9

PERIOD OF "CRISIS"

M P M A M P M A M P M

8 12 4 8 12 4 8 12 4 8 12 4 8 12 4 8 12

URINE PER 4 hrs 4 3 4 4 2 3 6 3 8 9 6 5

UREA PER 4 hrs 45 32 17 20 17 29 51 39 98 103 85 49

UREA % 2.5 2.4 2.5 2.8 2.1 2.2 1.9 2.9 2.7 2.6 3.2 2.2

GERALD

STEPHEN

Case (2)

Chart on
9th & 10th
days.

Showing
Temperature
Pulse & Resps.
Diet
Urine
Urea
Urea %

106°

105°

104°

103°

102°

101°

100°

99°

98°

97°

15-oz
milk

9

10

PULSE

RESPS

88 80 80 80 88 88 80 76 72 68
32 32 36 36 36 36 30 32 28 26

Pneumonia
L.L.L. (lower 2nds)

Name { Walter
Emple

Age 14 years.

Diet see chart

Case Book N^o

Case (4)
Notes of Case

See back

Case III in
1st series

Chart of 6, 7, 8, 9, 10th days
to show.

Temperature.
Pulse & Respirations

Diet.

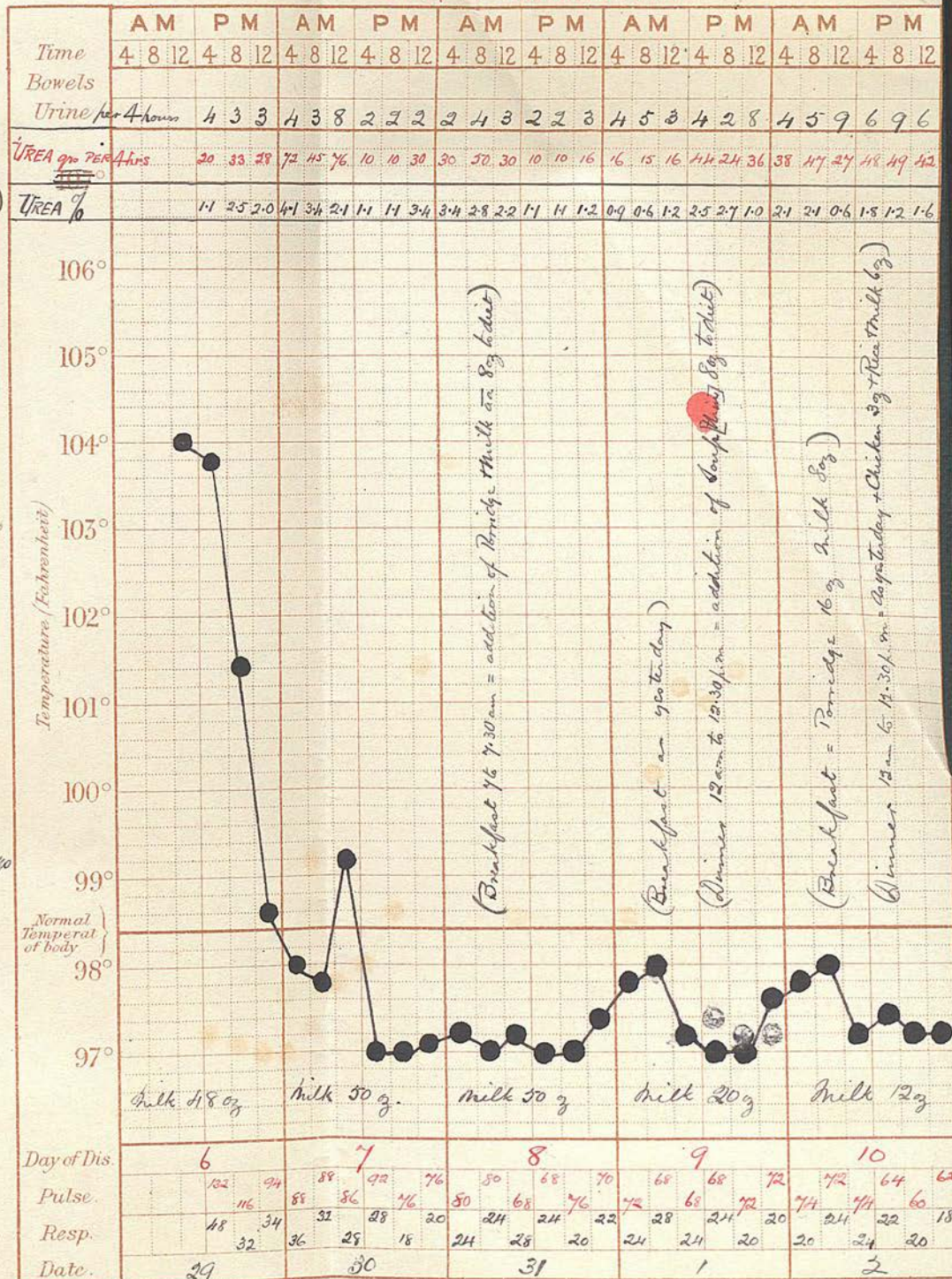
Urine
Urea
Urea % } 4 hourly.

Date of admission

24. 3. 1904

Result well.

"CRISIS" & "CONVALESCENCE"



DISEASE.

Pneumonia

Notes of Case.

Joseph

Name } Biondi

Age 23 years

Diet

Case Book N^o

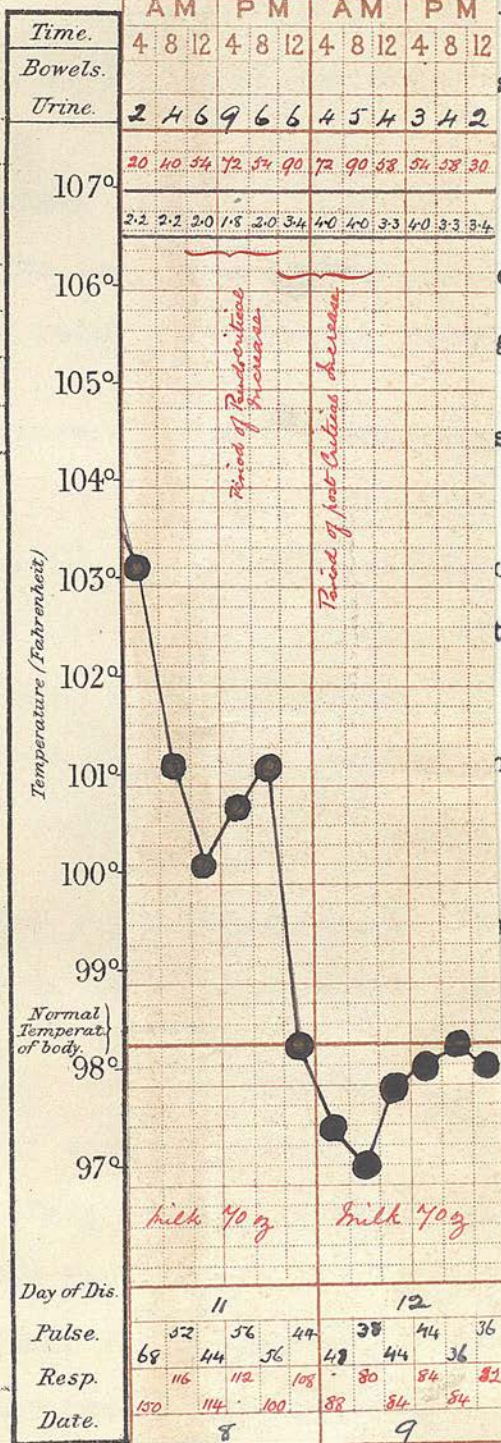
Case (5)

To show period
of Crisis
& "Break" in
Crisis.

Hourly notes.

Date of admission.

Result



Relation to Crisis and Lysis. Of a somewhat similar nature to the above increases is the temporary post-critical rise in Urea (and Urine) output seen in all cases ending by Crisis; and the post-lytical increase in Case X of the previous series (O'Donell).

The differences are:-

(1) That the increases of the post-critical type are usually relatively greater in degree, and

(2) That (compared with the increases after pseudo-crises), the increase in Urine at the time of the post-critical rise is not proportionally so great as the increase in Urea, whereas after pseudo-crises it is usually greater - giving the relatively lowered Urea percentage usually seen at these times (e.g., Cases (1) and (5)).

A few remarks on the appearances seen in these temporary increases in Urea and Urine are necessary.

I. Duration. The average duration of these increases is about three four-hourly periods (about 8 - 12 hours). They rarely, if ever, appear to extend into a fourth four-hourly period. Rarely the rise appears to last for a shorter period (4-8 hours) - this latter appearance is seen after some falls of temperature in the fastigium. in occasional cases.

II. /

II. Period of Commencement. In some instances the increase in Urea (and Urine) output is observed to begin in the same four-hourly period in which the fall of temperature is completed; (e.g., pseudo-crisis in Case (1), 8th day, and also 6th day in that Case), or, in the case of a crisis, in the same period in which the temperature first reaches normal, (e.g., Crisis, Case (1) 9th day, Case (2) 10th day, and Case (5) 11th day). In other instances the first appearance of the increase is seen in the four-hourly period following that in which the fall in temperature is complete (e.g., 5th day Case (4)), or in four-hourly period following one in which temperature first reaches normal in the case of a crisis (e.g., after Crisis in Case (4)). The explanation of this apparent difference in appearances is probably as follows :- The temperature is only noted once in each four-hourly period, and that is at the end of the period. The temperature noted, therefore, in each four-hourly period may have been reached at any time since the previous four-hourly note was made, i.e., may have been reached as much as $3\frac{1}{2}$ hours, or as little as 2 or 3 minutes before the temperature was noted. In the former case, the increase which follows the fall of temperature will have had time to set in thoroughly before the next period for collecting the Urine, estimating the Urea and noting the temperature, arrives /

arrives at the end of the four-hour period; and yet this will appear on the four-hour Chart as the first time the temperature reached normal. In the latter case, the increase will not have had time to set in properly, when the period for noting the temperature and collecting the Urine arrives, and therefore the increase will appear first in the following four-hourly period.

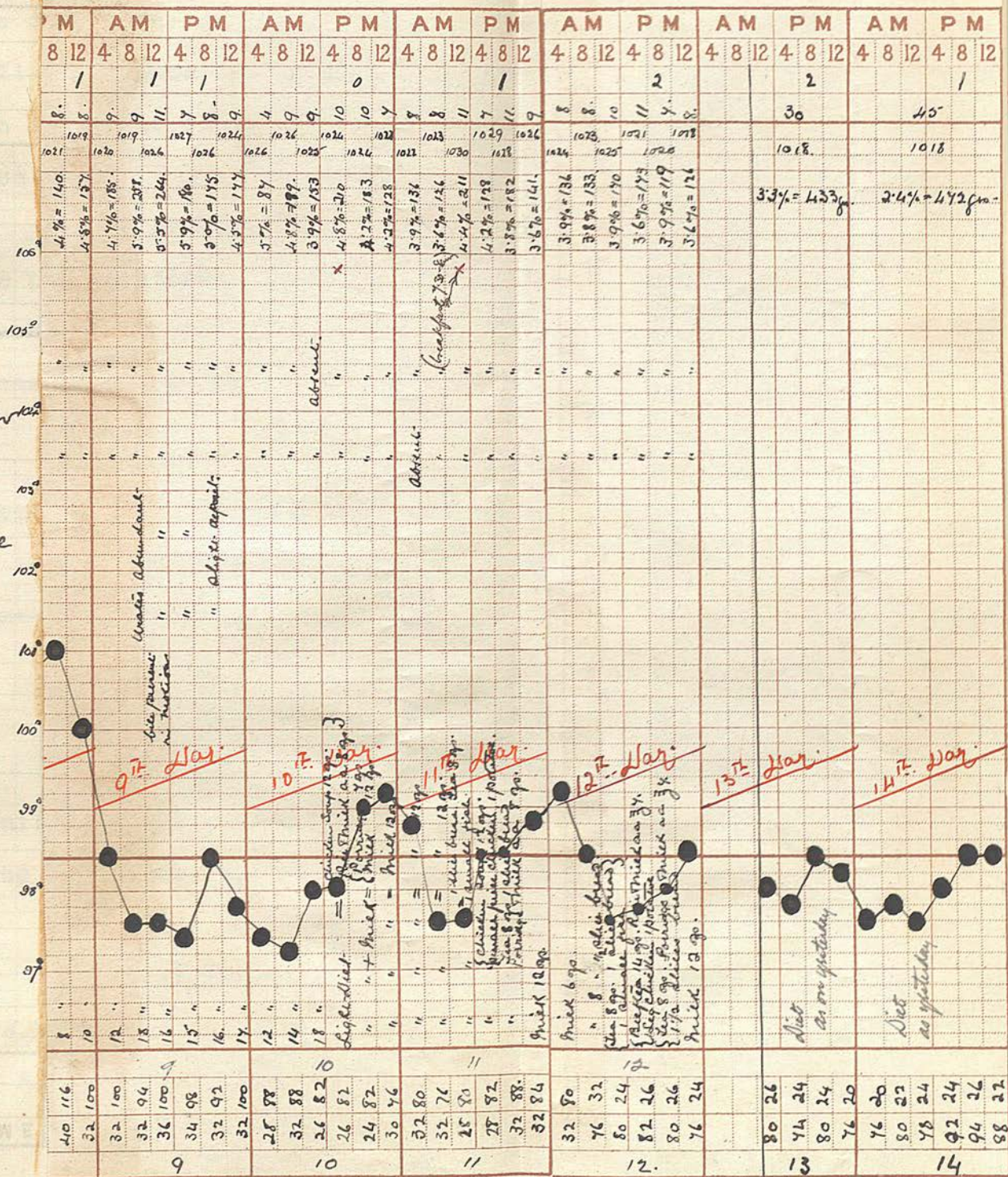
The above consideration lends support to the view put forward here and previously that the post-critical increase and the temporary increases occurring in the fastigium after certain falls of temperature (of the types previously noted) begin within a brief period (not more than four hours; probably a shorter time) after the completion of the fall in temperature which they follow (or of the crisis, as the case may be).

Course of the Post-critical Rise in Urea.

It will be noted that the increase in Urea is usually relatively greater than the increase in Urine at the time of the post-critical rise. This fact is evidenced by the increase in Urea percentage usually seen at these times, e.g., post-critical rises in Cases (1) and (5). It has already been noted that an opposite appearance is frequently seen at the time of post-pseudo-critical rises. The appearances in this /

Case ①

Chart to show
period of
convalescence



this respect seen at the time of falls of temperature in the fastigium, of the types previously noted, almost invariably resemble those seen at the periods of post-critical rise, i.e., shew an increased percentage during the period of Urea increase following the fall of temperature (see 6th day Case (1), 6th and 8th days Case (2), 7th-8th day Case (3), 5th-6th day Case (4)).

Climax of Post-Critical Rise. The climax of the post-critical rise in Urea usually appears to be reached about the middle of the 12-hour period of increased Urea output, e.g., Cases (1) and (5).

These post-critical increases seem to be irrespective of, or greater than can be accounted for by any differences in the amount of diet at these times, e.g., Cases (1) and (2).

The four-hourly observations in Convalescence.

For observation and comparison three cases are available, viz., Case (5), Convalescent period of Case (4), Convalescent period of Case (1). See back.

The Charts of these are appended.

The chief points to be noted in Convalescence
are :-

A. /

A. That there are irregular oscillations in the four-hourly amounts of Urine and Urea excreted (See Charts).

B. That these oscillations appear to follow no regular system of increase or decrease as the Case proceeds.

C. That the amounts of Urea and Urine are not apparently dependent on the variations in four-hourly temperature which occur in the same periods, or in the periods immediately previous in each instance.

D. That for the periods during which milk alone is given after the crisis (i.e., until additions to diet are made), there is no certain relationship between the amount (of milk) taken and the Urea and Urine excretion in each four-hourly period. The appearances at these times must be influenced by some more important factors. (See Cases (1) and (2) after "Crisis").

E. That when additions to the diet begin to be made the Urea (and Urine) excretion in the period 'day' (8 a.m. to 8 p.m.) begins to be greater than in the period 'night' (8 p.m. to 8 a.m.), but not definitely before such additions begin to be made. This is obvious from examination of Charts of Case (1) 10th, 11th, 12th days, and Case (4) 7th, 8th, and 9th days, and Case (5) 12th, 13th, and 14th days.

F. That with the addition of new substances, but especially solids or semi-solids, to the diet, there is an increase in Urea and Urine output. The increase is temporary, lasting for a variable time (4-12 hours), and appears to set in within 4 hours of the addition to the diet being taken. After this increase passes off, the Urea usually comes to about its original level.

Examples of these statements are seen in 3-

Case (1) 10th and 11th days.

Case (4) 9th and 10th days.

Case (5) 13th day.

G. That there is almost invariably a direct, though not proportional relationship between the amount of Urea and Urine in each four-hourly period.

H. /

H. That the Urea percentage oscillates irregularly in consecutive four-hourly periods.

Examples are :-

- Case (1) 10th, 11th and 12th days.
- Case (2) 10th day.
- Case (4) 7th, 8th, 9th and 10th days.
- Case (5) 12th, 13th, and 14th days.

Four-hourly observations were not continued long enough in any Case to note the appearances of the percentage as it approaches nearer to normal.

I. That there is usually an increase in Urea percentage temporarily following additions to diet, indicating an increase in Urea output out of proportion to the increase in Urine which is usually associated. This increased percentage sometimes appears in the same four-hourly period, sometimes in the four-hourly period following the addition. It endures for a variable period (about 4-8 hours). The percentage, however, is sometimes not increased (e.g., Case (5), 8 a.m., 13th day). This is possibly owing to some diuretic action of the food or to its containing more liquid than usual, or possibly to some other liquid, e.g., tea, being given which may not have been noted. Any of these causes might cause a relatively greater increase in the output of Urine than of Urea. I am unable to explain the appearance otherwise.

The fact that milk has been given at times between meal hours and the amount given in each separate four-hourly period not noted in the special periods in which they were given (e.g., on 10th, 11th and 12th days in Case (1), and in cases (4) and (5) there is only a note of the total daily amount given), makes the results of observations somewhat uncertain in the period of convalescence after changes in diet occurred in these cases. In some places only the more important additions to the diet shew results in Urea excretion which are at all striking.

J. That there is no apparent relationship between the rate of pulse and respirations and the amount of Urea and Urine excreted in the same four-hourly periods.

A GENERAL RÉSUMÉ of the RESULTS of OBSERVATIONS and
SOME CONSIDERATIONS THEREON.

(a) IN the FASTIGIUM.

The Urine :

- I. As no observation was made in any case before the fourth day, it is not possible to state whether the total daily amount of Urine was high or low at the onset, and in the earlier part of the fastigium. But it is notable that in every one of the cases daily output of Urine is subnormal in the part of the fastigium (excepting the day of pseudo-crisis in Case VI.) in which observations were made. Also there is not any certain evidence of a progressive decrease as the fastigium progresses, and therefore it seems not unlikely that the Urine has been subnormal from the beginning. This diminution in Urine cannot be accounted for by the loss of fluid in the sweat, faeces or sputum, as it is very marked in some cases in which there was little or no sweating, not much sputum, and no diarrhoea or looseness of the bowels. Some at least of the missing fluid may have been exhaled in the breath. It seems possible, however, ^{that} as Parkes¹ suggested, some /
- - - - -

¹ "On the Composition of the Urine" 1860, p.270

some of it is stored in the body. There is a sudden flush of Urine immediately after the crisis.

II. The Cases with low average daily Urea output in the fastigium have a markedly lower daily average Urine output than Case VI. which has a high average Urea output, i.e.,

Average 24-hourly Urine
in fastigium of Cases
I, II, III, IV, V, and
VIII.

19.8 oz

Average 24-hourly Urine
of Case VI. (excluding
8th day).

37.5 oz.

III. There are daily variations in the quantity of Urine, the total daily amounts differing in an uncertain and irregular manner. These variations are seen in all cases. They are not, apparently, in any definite association with the synchronous temperature variations.

IV. The total daily amount of Urine shows no apparent relationship, direct or inverse, to the average height of the temperature.

V. The total daily amount of Urine does not appear to depend on the amount of milk taken in the same period in any definite way.

VI. /

- VI. There is constant evidence of a direct, though not at all proportional, relationship between the amount of Urine and Urea output in the same daily period.
- VII. After the completion of certain falls of temperature in the fastigium, there is usually a temporary increase in Urine output associated with a similar increase in Urea.
- VIII. When a pseudo-crisis (or what is much the same, a 'break' in the crisis) occurs, there is a marked increase in Urine output for a period of 12 hours or so. The Urea % is temporarily reduced as a rule at this time. This is well seen in Cases I. II. and VI.
- IX. In the 4-hourly periods, no ratio or relationship is evident between the total amount of Urine and the temperature or diet; or both considered together: nor do the variations in Urine output which are observed in the 4-hourly periods appear to depend in any way on the temperature and diet in these periods.
- X. The direct, though disproportional relationship, between the total Urine and Urea output is as evident in the 4-hourly as in the daily periods.
- XI. /

XI. The amount of Urine does not appear to vary definitely with the periods "day" or "night" during the fastigium.

XII. The 4-hourly variations in amount of Urine do not conform to any rule of progressive increase or diminution in the progress of the fastigium towards its termination.

The Urea :

I. Position of the affected area. In these cases it does not appear that the appearances seen in the course of the Urea excretion in Lobar Pneumonia vary according to the portion of lung involved. In two Cases - one, a man, (Case IX) and the other a boy of 10 years, (Case IV) - the Right Upper lobe is affected. In another - (Case V.) an adult - the Left Lower Lobe is involved; and yet (excluding Cases VI, and VIII), the cases all shew very similar results in the fastigium and in convalescence. (N.B. Effect of diet in Cases IV. and V). The fact is also to be observed that in Cases VI, and VIII. which differ in amount of daily Urea output, from all the other cases, (as we shall presently discuss) the same part of lung is involved as in the majority of the other cases. Therefore, this difference in amount of Urea output in the fastigium does not appear to depend on the part of the lung involved.

Nor does it appear to depend on the age of the patient. Case VI. with high Urea output is an adult, but there are two other adults among the cases (cases V. and IX.) both with low Urea output. Case VIII is the same age as Case I, and yet appearances are hardly the same in each.

II. Age, indeed, is a factor which does not appear to affect appearances - in this series of cases at least. Cases occur at the following ages, 10, 14, 16, 20, and 33 with low fastigial Urea, which all shew a marked similarity in appearances throughout the course of the disease (i.e. so long as observations continued) and the case at 34 years (VI) has high Urea output. Case VIII. can hardly be included, because of the effects which falls ^{of temperature} probably have on Urea output.

III. Sex. I have at different times made observations upon three adult females, and one girl of 13 years - all normal cases ending by crisis. All these cases also showed low fastigial Urea and appearances otherwise similar to the class of male cases, in above series, with low Urea output. I have not introduced them here because the Urea was only noted every second day in each, and, though the general conditions of Urea excretion were obvious, the cases would not admit of close comparison with the cases of this series.

Von Jaksch's¹ statement then, that the Urea output is high in children, is not borne out by Cases III and IV of this series, and in the girl of 13 years of whom I have just spoken; but, of course, the cases are few, and I can quote no cases of less than 10 years old.

It appears to me beyond doubt, however, that differences in "Age" (above 10 years) and "Sex", do not, of themselves cause different types of cases as regards Urea and Urine output in the fastigium.

- IV. No observations have been possible in any of the cases at the time of onset of the disease, or in the first 2 - 3 days of the fastigium, but as there is no certain evidence in any of the cases of a progressive diminution in daily Urea output as the fastigium progresses, it does not seem probable that the daily Urea output is greater at the onset of the disease than afterwards in the fastigium. In two cases quoted by Parkes ("Urine". 1860 Edtn. p. 271 aut seq.)² in which examination was begun /
-

1. R. Von Jaksch 'Clin Diag' - (see chapter on 'the Literature' ante.)
2. The two cases quoted were observed, I think, by Metzger.

begun on the second day of illness, the total daily amounts were considerably less on the 2nd and 3rd days than afterwards.

V. From a consideration of these cases, it would appear that there are two great classes of cases.

- (a) Those in which the Urea excretion is diminished in the Fastigium.
- (b) Those in which it is increased.

This fact is suggested by Samuel West. West's 5 cases all shewed diminished excretion in the Fastigium. In Parkes'¹ collection of cases, I find that nearly all show increased Urea output in the fastigium, though he quotes 3 cases by other observers in which the Urea was diminished.

I am in accord with ~~these~~ observers in so far as the question of the two great varieties of cases is concerned, but my series of cases, though comparatively few in number, appear to indicate that the type with low total daily Urea output in the fastigium is much the more common variety.

In 6 cases of this series the Urea output in the fastigium is low, and in two (Cases VI, and VIII), it is above normal. Case VIII. only shows 1 day, however, and therefore is not of great value.

Daily /

¹ "On the Composition of the Urine". Parkes 1860 p. 270 et seq.

Daily average fastigial
Urea for Cases I.II.III.
IV. V. and IX.

Daily average for Case VI.

232.1 grs

708 grs(excluding day of pseudo-
crisis).

For 1 day of Case VIII.

585 grs.

(This case can hardly be in-
cluded in this consideration,
however, because of the pos-
sible effects which the falls
of temperature on that day
have in increasing the Urea
output, as we have seen in
the discussion of it previ-
ously).

For the 4 female cases, of which I have spok-
en, the average was low. For the 3 adult female
cases it was below 300 grs, and in the female child
of 13 years, the average was 158 grs for 2nd, 4th
and 6th days. (Crisis on the 7th day).

VI..Though these two great classes of cases show differ-
ences as regards the relative amount of Urea in
the fastigium, they, in other respects, show very
similar appearances. The progress in each var-
iety is essentially the same.

The Urea output in each follows much the same
course in the fastigium. The irregular variations,
the results of certain falls of temperature in the
fastigium and of pseudo-crisis, and the post criti-
cal increases occur in both varieties. Moreover,
the ratio of the amount of the post-critical
rise /

rise in Urea to the average amount excreted for a period of similar duration in the fastigium is much the same in both types of case, though the actual amount of post-critical increase in Case VI. may be more striking.

In convalescence the temporary fall in Urea after the post-critical rise, the variations in amount of Urea excretion in the different periods and the effect of alterations in diet, are apparent and similar in both types. The tendency in both classes of cases for the Urea to return to normal is the same, but the return to normal involves in the class of case with high fastigial Urea a more or less progressive decline, and in the other class a more or less progressive increase. The Urea percentage in the fastigium is higher in the variety of which Case VI. is the type, than in the other type, but the average proportion of the degree of percentage to total amount of Urea excretion is about the same.

It does not seem that the appearance of a high or low Urea output is in any way dependent on the apparent severity of the case in which either occurs. V.Jaksch (and before him Parkes¹ and others) says that any disease with diminished Urea must be regarded as having a bad prognosis). Case VI. showed no symptoms or signs which led me to think that /

that the patient was less severely ill than most of the other cases examined. Case VI. however, showed, if anything, a more rapid return to about normal than did the majority of the cases with low fastigial Urea, and it seems possible that such an appearance may indicate a less marked constitutional disturbance in this case and others like it: but it must be remembered that the personal equation cannot be omitted from any comparison instituted on these lines.

VII. The amount of Urea excretion in the 4-hourly periods does not appear to depend upon the general height of the temperature, nor upon the amount of diet taken; nor the degree of interference with the excreting power of the kidney cells, if presence or absence of albumen in the Urine be any indication of the degree of cloudy swelling in these cells. Cf. Case VI. and others.

VIII. In Case VIII. we observe certain appearances which are not in apparent conformity with either of the above types. It is possible that the apparent absence of a post-critical rise in this case is due to the fact that an increase in Urea output following the two falls of temperature on the day before the completion of the crisis, masks /

masks, what would otherwise be a post-critical increase on the day of crisis. This has been suggested in the special consideration of this case. Certainly, as I have previously pointed out, the amount of Urea output noted on the day of crisis in this case is greater than the amount registered on the day of post-critical rise in some other cases in the series.

The alternative view is that this case is an illustration of a third type of case as regards Urea output in pneumonia, the feature of which type is an absence of a post-critical rise, there being instead a gradual decline covering the period of temperature fall at the end of the fastigium, and lasting two days or thereabouts. But the almost clock-work regularity with which the post-critical rise, - and other increases after pseudo-crises and after certain temperature falls in the fastigium - appear in all other cases, makes me sceptical regarding this latter view. No definite opinion can be formed, however, from this one case, showing as it does only one day of the fastigium, but the possibility of a third type of case must be borne in mind.

IX. There are daily and 4-hourly variations in the quantity of Urea, the total amounts differing in an uncertain and irregular manner. These variations are seen in all cases.

X. /

X. Relation of Urea to temperature. These variations in Urea output are not apparently in association with the variations in temperature occurring at the same time in the daily or 4-hourly periods. Nor is there any apparent relationship, direct or inverse, between the amount of Urea output and the average degree of temperature. The only apparent relationship between Urea output and temperature in the fastigium is the increase almost invariably seen after the more evident falls in temperature. When a rather greater fall in temperature than usual occurs, in a case where the temperature has been more or less steady for a time the Urea increase is usually very evident (e.g. Case I. 6th day: IV. 6 - 7th day and V. 4 - 5th day), after its completion, but the increases are sometimes less marked in cases where the temperature has been swinging (e.g. Case III, 5th and 6th days) owing to the Urea increases due to previous falls of temperature having hardly had time to wear off before the next increase is due to appear. I find no evidence of a rise of temperature being associated constantly with either an increase or a decrease in Urea output. When we consider that - as we have just seen - the Urea may be either increased /

increased or diminished during the fastigium, (i.e. when the temp is high), we cannot be surprised to see different appearances associated with a temperature increase in different instances.

XI. The question of whether these previously noted increases in Urea output in the fastigium may not be due to the onset of a temperature fall, has been considered previously. There is an absence of relationship of amount of Urea output to diet (milk) in both daily and 4-hourly periods.

XII. There is an absence of relationship between, on the one hand, diet and temperature considered together in any form of combination and amount of Urea output on the other. The question of the possibility of a relation being seen, were more frequent examinations made, has been discussed.

XIII. There appears to be some unknown factor influencing the Urea excretion in the fastigium. The evident lack of relationship between amount of Urea and of the temperature and diet considered together may be due to the fact that this supposed factor may at some times act in conjunction with the temperature and diet and at other times against the temperature and diet. If this were so, the variations due to the effects of temperature and /

and diet would be accentuated by the effect of this unknown factor in some instances, and diminished or counteracted in other instances, thus accounting for the apparent lack of Urea relationship to temperature and diet. It might also account for the fact that there are very occasionally apparent exceptions to the general rule observed regarding increase in Urea output after certain falls of temperature in the Fastigium and for the fact that after a large fall in temperature in places, we only observe a small increase (this when the factor is against the temperature). The question of what this factor may be has been discussed under "4-hourly observations".

XIV. The same may be said to apply to the effects of periods "day" and "night" on Urea excretion. There is no apparent relationship of Urea and Urine output to the time of day in these observations during the fastigial period.

XV. There is almost invariably a direct relationship between the amount of Urine and Urea output in the daily or 4-hourly periods. There is no constant proportional relationship between the quantities however.

XVI. A close relationship between the Urine or Urea excretion /

excretion and pulse and respirations is not obvious.

XVII. The variations in daily Leucocyte count do not show a definite relationship to the variations in amount of Urea excretion.

XVIII. There is a temporary increase in Urea and Urine output lasting for a variable period (about 8 to 12 hours) after pseudo-crises, e.g. Cases I. and VI. and "breaks" in crises (which are similar phenomena) e.g., in Cases II. and V. The output of Urine is (relatively to Urea output) more marked at these times than after temperature falls in the fastigium, or after crises.

The Urea percentage :

- I. The average percentage is invariably high during the fastigium.
- II. There are irregular variations in the daily and 4-hourly periods, the percentage sometimes even reaching a subnormal point, but rarely remaining so for more than one 4 hour period at a time.
- III. The percentage usually shows an increase with the Urea increase after marked falls of temperature in the fastigium, but not invariably so. A decrease in percentage is seen with the Urea and Urine increase after the pseudo-crises in Cases I. /

I. and VI. and after 'broken' crises in other cases. The decrease in percentage is due to a disproportionately great increased Urine output at these times.

IV. I have already mentioned that the type of case with high fastigial Urea appears to be associated with a more or less proportionately higher percentage than cases of the "low Urea" type. (cf. Case VI. and also Case (3). in series 2 (both having high percentage) with other cases.)

V. The degree of percentage does not depend on the height of the temperature or amount of the diet in the same period.

VI. The percentage does not vary definitely with the periods "day" or "night".

VII. It does not depend on the volume of Urine in the daily or 4-hourly periods, nor does it constantly vary, either directly or inversely, as the Urine, or as the Urea, in these periods.

The APPEARANCES at the END of the FASTIGIUM.

There is a temporary increase in Urine and Urea output seen (in all cases but Case VIII) for a period of 8 to 12 hours after the crisis (and in one case /

case, the lysis) is complete. This increase is more marked than any seen after previous falls of temperature during the fastigium in each case. It is associated with a temporary increase in Urea percentage. A curious point of note is the fact that the increase appears to begin within a very short time of the temperature first touching normal, though, after crossing the normal line, the temperature may continue to fall for some hours.

I am unable to state definitely the cause of this post-critical increase.

A. It is obvious that it cannot be accounted for by the amount of the Nitrogenous diet in most cases. In all the cases the diet remains practically the same during the increase as it did before it began; and though certainly the power of digestion will speedily improve with the lowered temperature, the total milk taken on the day of the rise, would not, in most of the cases, contain sufficient albumens to furnish the amount of Urea excreted on that day.

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B. Professor Allbutt and others have suggested that it is due to absorption of the pneumonia exudate in the affected lung. If this were true, it is unlikely that the post-critical increase would begin so ~~definitely~~ at the exact time the temperature reaches normal, and that it would last for /
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for such a brief and constant period of time. Observations on the living subject and in the post-mortem room indicate that absorption of the pulmonary exudate is a ^{comparatively} slow and gradual process. If the increase were due to absorption of exudate we should then expect the increase to last for a more lengthy period, but in all the cases we see a more or less marked fall away in amount of Urea and Urine excretion within 16 - 20 hours after the crisis is completed.

Again the increased output of Urine, at the time of post-critical rise, which is evidently closely related to the increase in Urea output, cannot I think be due simply to absorption of exudate.

C. It may be due to a mere flushing out of the kidneys by the increase in water which we see at this time. The watery part of the Urine is decreased while the temperature is high in the fastigium as we have seen, and there is an increased output of water with the completion of the temperature fall. That this is the sole cause of the increase is doubtful. The usual appearance of an extra high Urea percentage with the post-critical rise, seems against this view.

D. ¹Cabot affirms, (and others have stated a similar view) that Urea may be formed in the body and yet /

¹ Simon "Clin. Diagnosis", 1905.

yet not necessarily excreted at once. In other words it may be stored up and excreted later. Hutcheson has shown that such a storing up occurs of the Urinary Chlorides in Pneumonia, and it is not impossible that a similar occurrence may take place in regard to Urea. This storing up may occur in the Fastigium in Pneumonia, and result either (a) from deficient power of excretion by the kidney cells, which, if we may judge from the presence of albumen in the Urine in nearly every case, are in an unhealthy condition.¹ That such a deficient excretion does occur seems probable from the fact shown by Von Jaksch (Clin. Diag. p.101) that there is a great increase in the percentage Urea in the blood in Pneumonia without uraemic symptoms necessarily appearing; or (b) from there not being enough water secreted to carry off all the Urea that may be already in the tubules. For, as we have seen, the watery part of the Urine is always decreased during the pyrexia. Also, though the solubility of Urea in ordinary water is great, yet it may be that the Urine of the pneumonic fastigium, loaded as it is with other substances in solution, has its solvent powers so reduced that it is not able to dissolve and carry off so much Urea as a healthy Urine could. Thus all the Urea excreted may not be carried off during the fastigium. When the fever disappears /

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"Cloudy Swelling".

disappears there will be a rapid increase in amount of water and also probably an increased power of excretion by the secreting cells of the tubules, owing to their tendency to return to a healthy state when the fever is gone. The post-critical rise in Urea may then be due to the combination of these two factors, i.e. increased power of secretion of Urea by the kidney cells and the removal of more of the Urea already in the tubules by the increased amount of Urine occurring at that time.

The fact that, in cases in which albumen occurs, it does not necessarily, or indeed as a rule, disappear from the Urine till a variable time after the post-critical rise is over, is not necessarily against the above view, as the improvement in condition of the kidney cells may be great before albumen ceases to appear in the Urine. But the suddenness, rapidity, greatness and regularity in appearance and duration of the increase lead one to think that this theory is hardly a satisfactory one in all respects, though I believe it is one of considerable account in the causation of the post-critical rise.

If we accept none of these views, then all that is left to us in the state of present knowledge is to hold with Virchow, that it is due "to the completion of the pyrexia". This, of course, is hardly an /

an explanation. The result must be brought about through the effects of the cessation of pyrexia on the factors which (1) influence the formation of Urea, or (2) prevent its ^{elimination} ~~excretion~~ during pyrexia. What these factors are is another matter. It is interesting to observe that an almost exactly similar type of increase in Urea and Urine has been seen to start after the completion of pseudo-crisis, of breaks in crisis, and of certain falls of pyrexia in the fastigium.

During the Lysis in Case X. the average Urine, Urea and Urea percentage are all low. The Urine and Urea obviously do not vary either directly or indirectly or inversely with the average degree of temperature. No definite statement can be made as to whether there is a gradual increase in Urea and Urine as a lysis proceeds. It may be so, though from the post-lytical rise which appears in this case when the temperature reaches normal, it seems unlikely: besides in other cases we only see an increased Urea output begin at completion of a fall in temperature. But the increase due to the falls of temperature on the second day of lysis in Case X. more or less obscures all other appearances. The daily Urea percentage varies inversely with the degree of temperature in this lysis, though whether this is always so or not, I cannot say.

Otherwise /

Otherwise the progress of the case is much similar to that of cases ending in crisis.

The Urea percentage during the period of post-critical rise is usually higher than at any previous period of the disease.

In CONVALESCENCE.

I. After the completion of the post-critical rise there is, in all cases, a more or less marked fall away for 12-24 hours (or occasionally rather longer) in the output of Urine and Urea, This fall away appears less marked in Case VI. in which the Urea has been all along above normal: but this is probably due to the fact that the subsequent increase usually seen after this period of reduction, is to some extent counteracted in Case VI. and made to appear less, owing to the daily reduction in Urea which in this case has to occur if the Urea is to return towards normal. In other low Urea cases where the Urea must show an increase in order to reach normal, the increase after this temporary reduction is naturally apparent. This subsequent increase would appear in some of the cases to be due to additions to the diet, but in other cases the increase is still seen where the diet remains /

remains about the same up to this time. On this day the Urea is usually about normal in the type with high fastigial Urea, and below in the others.

II. From this time onward, two opposite appearances are seen in the series of cases.

(a) In the Cases with low Urea, there is, over all, a more or less gradual increase to about normal. The amounts of daily Urine, and Urea, usually reach to around normal about on the 9th day after completion of crisis or later. From that time onward, the amounts appear to oscillate about normal.

(b) In the case with high Urea, there is over all a more or less gradual decrease to about normal. From that period it would appear that there are oscillations about the normal. The period "about normal" would appear to be reached rather earlier in Case VI. (of the high Urea type) than in cases of the low Urea type, though not in all.

III. Both series of cases in their progress towards normal show irregular daily and 4-hourly oscillations, which may depend on various causes, but chiefly on additions to the diet.

IV. One of the most striking features in the whole study /

study of the cases is the effect of additions to the diet. With each marked addition a very definite increase in Urea, (and a less marked increase in Urine) output is usually seen. The increase in Urea would appear to be almost invariably accounted for by the amount of the increase in nitrogenous material. The increase is especially marked in Cases IV. and V. where the difference in amount and nature of the dietary additions are most striking. This latter appearance (seen in Cases IV. and V.) seems to bear out Leathes'¹ suggestion that a part (in these two instances a large part) of the nitrogen taken in the food is not used by the body after it is absorbed, but after being passed to the Liver and formed into Urea, is passed direct to the Kidneys where it is excreted at once.

V. There is usually a temporary increase in Urea percentage with the increase in Urea after dietary additions. This is not invariable, however, as the increase in Urine output is sometimes as marked as, or more marked than, the Urea increase on these occasions. Whether this /

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¹ Problems in Animal Metabolism, Leathes, see ante.

this is due to diuretic action of any substances in, or taken with, the food (e.g. condiments as salt, etc.) I am unable to say.

- VI. There is a rapid return to original "equilibrium" when the effect of the dietary alteration wears off. It would appear that the more marked the nature and extent of the dietary change, the slower is the return to about the average line of ascent or descent as the case may be, (i.e. the period, during which the results of dietary additions are seen to last, varies.) It extends from between 4 and 8 hours to more than 12-16 hours.
- VII. The rate of return of the Urea to normal appears to keep pace more or less with the rapidity of the process of resolution (as judged by the physical signs) and with the return of the respiration rate to about normal.
- VIII. In the great majority of cases the Urea percentage shows over all a decline towards normal which is usually reached rather before the return of the Urea and Urine to about normal. This is not seen in every case however. There is in all the cases, except one, a temporary increase in Urea percentage at the time of the post-critical /

post-critical rise in Urea. This wears off about same time as the post-critical rise finishes, and is sometimes followed by a temporary fall in percentage below the average line of descent: at other times this latter appearance is not seen.

IX. During Convalescence the fall in percentage is usually slight while additions are being made to the diet, the increase in percentage with a change in diet appearing to counteract the tendency of the percentage to decrease towards normal. After dietary additions cease, the fall away in percentage is usually marked. There are frequently irregular oscillations seen in the daily Urea percentage, but this appearance is more definitely marked in the 4-hourly periods, apart from those oscillations due to diet. After the percentage comes to about normal (2%) it shows oscillations about the normal in the daily periods.

X. In the 4-hourly periods the amounts of Urea and Urine output show oscillations apparently quite independent of the oscillations of temperature and general amount of diet so long as the latter remains of the same nature (there are increases of course, as already pointed out, with great additions to diet and changes in its nature.

XI. /

- XI. Greater relative excretion of Urea and Urine during the 12 hours of the day than of night, becomes apparent first when the dietary additions are allowed and the nitrogenous intake during "the day" thus increased in proportion to that during "the night".
- XII. There is almost invariably a direct, though not proportional relationship between the amounts of Urine and Urea in the 4-hourly periods.
- XIII. When temporary rises in temperature occur in convalescence (such as seen in some cases) there is an increase in Urea (and Urine) output after the completion of the fall. (see Case IX.)

The daily Leucocyte count is usually high during the fastigium. It shows irregular oscillation which, on the whole shows a relation to the temperature. There is almost invariably a crisis in the amount of leucocytes closely associated with the temperature crisis. The fall by lysis in some cases sometimes occurs at the same time as the crisis, and sometimes a few hours after. Occasionally while the temperature falls by crisis, the blood count shows a gradual reduction (extending over a considerable period, i.e. a lytical fall). The relationship of daily number of leucocytes to the daily amount of Urea and Urine is not close.

The Pulse shows a general relationship to temperature. The 4-hourly variations in pulse do not follow those in temperature very closely. There is usually a critical fall in pulse rate at the time of the crisis in temperature, but on one occasion the pulse rate falls by lysis after a crisis in temperature has occurred (e.g. Case VI.). The relation of the pulse rate to the quantity of Urea excretion in the same daily or 4-hourly periods is somewhat similar to that of the temperature, Though appearances of relation of pulse to Urea differ somewhat from those of temperature to Urea output a definite relationship is not any more evident.

The Respirations. In observing the temperature, pulse and respirations, the respirations are always seen to be the last to return to normal. The respiration rate usually shows a critical fall to about 22 or 24 per minute about the time of the crisis, but from that period its return to normal is usually delayed for about a week or more.

The conclusion reached from a comparison of the pulse rate and amount of Urea output in the same periods during the fastigium and at time of Crisis applies almost exactly to the comparison of respiration rate and amount of Urea output. The relationship in point of time between the rate of return to about normal of the Urea output and of the respiration rate has already been noted.